

Case study 8: Producing ITER's Poloidal and Toroidal Field Coils allows Europe to become one of the world industrial leaders in superconducting magnets (ASG Superconductors)

The company

ASG Superconductors is a manufacturing company specialized in superconducting and resistive magnets. Superconductors are able to withstand higher currents than normal magnets, such as the ones used in the ITER tokamak which have to contain the plasma. ASG Superconductors has acquired industry-leading know-how in the design, development, production, installation and testing of superconductive and resistive magnetic systems, cryogenic systems, superconducting solenoids and coils, magnets for cyclotrons and components for made-to-measure applications. ASG's skills go from design to production to the complete test of systems and magnets. The company's biggest know-how is the fields of research, nuclear fusion, particle physics, applications for energy and medicine and the magnet projects it is working on. ASG also focuses on other parts of the superconductivity market, namely healthcare (MRI and Therapy), fault-current limiters and application to energy production. The average turnover of the company is around EUR 35-40 million. ASG Superconductors employs about 170 people (including white and blue-collar workers). ASG also owns two smaller companies (based in Genoa): Columbus Superconductors and Paramed (specialized in medical systems associated with Columbus). With these two companies, the total staff amounts to about 230 employees.

Main case-study characteristics

ASG Superconductors was awarded the contract for the construction of the ITER Toroidal Field Coils as part of a consortium with Iberdrola and Elytt Energy (in 2010). The coils are under construction in a new 28,000 m² production facility in La Spezia, Italy.

In 2012 ASG was awarded another order for "Engineering Integrator" activities as part of work on the construction of the poloidal field coils (PF2-PF3- PF4 e PF5) and the cold testing of PF6.⁹²

Main characteristics		
Company		ASG Superconductors
Country		Italy
Contract 1	Contract title	Full Scale Dummy Pancake/Prep (OPE-053)
	Contract value	EUR 156M
	Contract period	2010- Ongoing
	Consortium	Iberdrola Ingeniería y Construcción SAU, ASG Superconductors SpA and Elytt Energy SL
Contract 2	Contract title	Engineering Integration Services for the Supply of the Poloidal Fields Coils - PF2 to PF5 Coils (OPE-344)
	Contract value	EUR 27.5M
	Contract period	2013-Ongoing
Total contract value		EUR 183.5M
ITER Component		Magnets
F4E Work Package Code		11

⁹² ASG Superconductors, ITER Poloidal Field Coils, (<https://www.asgsuperconductors.com/doc/ITER-PFC.pdf>)

Description

ITER Toroidal Field Coils

The fusion process in ITER involves two hydrogen isotopes, deuterium and tritium, heated to temperatures in excess of 150 million °C, forming a hot plasma. Strong magnetic fields are used to keep the plasma away from the walls; these are produced by superconducting coils surrounding the vessel, and by an electrical current driven through the plasma.⁹³

The heat produced from the thermonuclear reaction by ITER, through proper heat exchangers (steam generators), will allow the production of electric power by a standard turbo-alternator group. The ITER device will operate with a system of superconducting magnets which relies on the Toroidal Field Coils, the Central Solenoid, the Poloidal Field Coils and the Correction Coils. Europe will manufacture 10 of the 19 Toroidal Field Coils, including a spare one, while Japan is responsible to produce the remaining nine. Winding packs of this size have never been manufactured before.⁹⁴

The European Domestic Agency Fusion for Energy has signed a contract for the supply of ten winding packs for the ITER toroidal field coils with a European consortium that brings together Iberdrola Ingeniería y Construcción SAU, ASG Superconductors SpA and Elytt Energy SL.

The signature of this EUR 156 million contract is a significant step for the ITER Project and an impressive technological milestone given the fact that winding packs of this size have never been manufactured before.

ITER Poloidal Field Coils

The Poloidal Field Coils contribute to generating the magnetic field to control the plasma position, maintaining the plasma's shape and stability inside the tokamak in order to provide the conditions for the fusion reaction. The Poloidal Field Coil system consists of six horizontal, circular coils placed outside the toroidal magnet structure. As their very large size makes it impossible to transport them, manufacture of four of the six Poloidal Field Coil will take place in the PF coil winding building, directly on the ITER site in Cadarache, France.⁹⁵

This contract is the first of a number of work packages which will cover tooling and equipment necessary in order to manufacture and handle the components, as well as site and infrastructure, manufacturing and cold testing. These work packages are currently being prepared in order to provide F4E's contribution of Poloidal Field Coils 2-6 (PF coils 2-5 will all be manufactured in Europe, while PF coil 6 will be manufactured in China, but cold tested in Europe; the Russian domestic agency will procure PF coil 1).⁹⁶

Main impacts

New business opportunities

The work done in the context of ITER allowed ASG to develop knowhow and further specialise in the international physics market. Two years ago, ASG acquired a project related to the field of high-energy physics in Germany which will allow the company to further diversify its portfolio. This project will also

⁹³ ASG Superconductors, ITER Toroidal Field Coils, (<https://www.asgsuperconductors.com/doc/ITER%20TFC.pdf>)

⁹⁴ Europe signs contract for toroidal field coil winding packs, 22 July 2010, (<https://www.iter.org/fr/newsline/-/349>)

⁹⁵ EU awards engineering contract for poloidal field coils, 22 October 2013, (<https://www.iter.org/fr/newsline/286/1740>)

⁹⁶ PF coils Engineering Integrator contract signed, 15 October 2013, (<http://fusionforenergy.europa.eu/mediacorner/newsview.aspx?content=724>)

allow to support the already developed technological processes. It will contribute to ASG Superconductors minimising the decline of production after the ITER contracts have been delivered by focusing on this new project.

The biggest investment realized by ASG Superconductors in order to be capable of delivering the components in the context of the ITER project was the EUR 60 million 25 000 m² production plant, built in La Spezia, Italy.

Employment and growth

According to ASG Superconductors, around 50 people work in the manufacturing of the toroidal field coils. They are based in the facility in La Spezia, Italy. Further to that around 10 more engineers work in Cadarache on the follow-up of production which has already started. In total 60 people are involved just in the design, manufacturing and construction of the toroidal field coils.

ASG Superconductors employs high-level engineers who have to be hired on a long-term basis and have to be provided with steady and constant amount of work. The professional growth policy and mission of ASG Superconductors is it to provide nuclear fusion experts options and possibilities in various fields in order for them to specialise in a wide range of applications.

ASG Superconductors is also involved and working on CERN related projects and activities, namely in the field of superconducting magnets.

Human capacity building

ASG Superconductors has managed to attract new engineers and further train and expand on the professional capabilities of their staff. Working on ITER related activities has also allowed ASG to further develop knowhow and successfully bid for other high-end physics related projects. The work done for ITER has also contributed to the increased competitiveness and recognition of ASG Superconductors on the international physics research and activities market.

Innovation and technology transfer

At this stage, no specific patentable knowhow has been reserved. There are ongoing queries on patenting a precise magnetic measuring technique, specially developed for ITER that can detect with great precision volumes of magnetism. It was developed through the research and development work done in the context of the two contracts for delivering Poloidal and Toroidal Coils.

Conclusion

The case of ASG Superconductors highlights the positive impacts that the ITER project has on stimulating the European high-end physics in general and the superconducting magnet industry, in particular. According to the company itself, at this point it is very difficult to envision how these technologies could be applied in the public sector. The activities carried out by ASG Superconductors as part of the ITER design, manufacturing and construction have allowed them to attract new staff and develop knowhow, enabling them to diversify the markets they operate in. It has also contributed to the construction of new manufacturing plant in the small Italian town of La Spezia, which has stimulated the local economy by attracting hi-tech and well payed jobs. Even though potential synergies with other companies, outside the consortium they are part of, have not occurred, the work delivered for the ITER project has allowed ASG Superconductors to establish itself as one of the main

players in the global market for superconducting magnets. The research carried out by the company in the context of ITER also permits for the development of innovative materials. It also allows for the implementation of new research in particle physics, which can have potential spill-over effects for other industries.