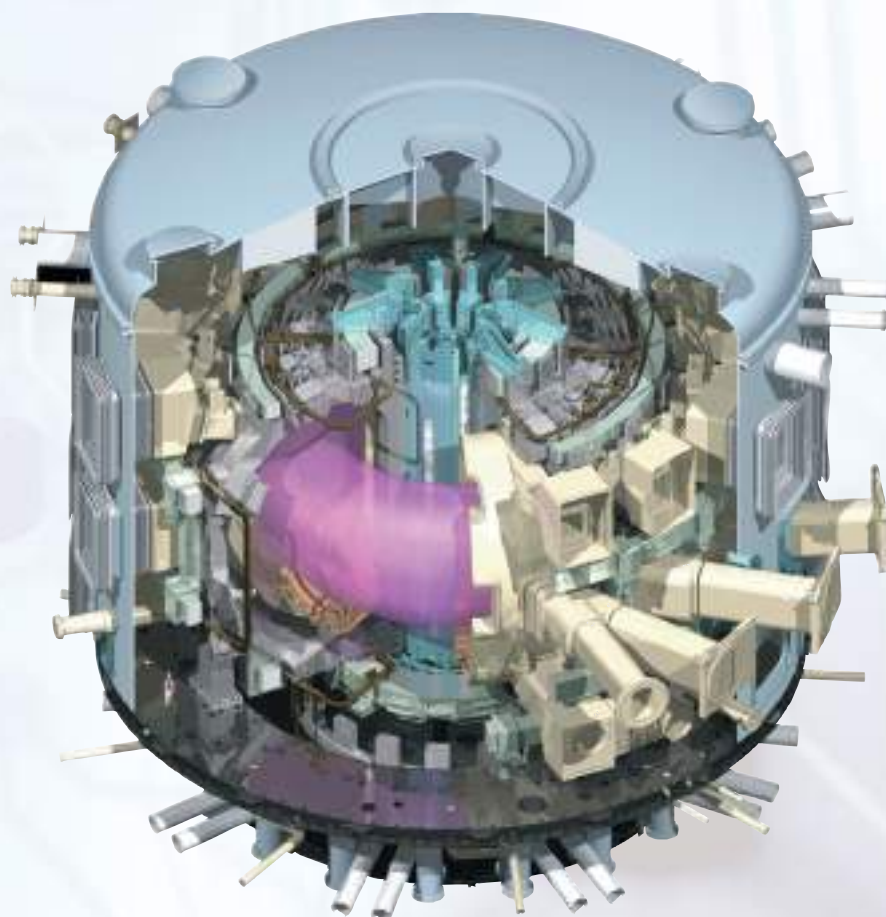


SPANISH COMPANIES ACTIVITIES IN FUSION



CDTI Centro para el Desarrollo
Tecnológico Industrial



Cimat
Centro de Investigaciones
Matemáticas, Modelización
y Tecnología

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SPANISH ACTIVITIES

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Foreword

Energy demand is foreseen to double by 2050 as population growth and energy consumption per capita in developing countries intensify. Currently, the European Union (EU) imports more than 50% of its energy needs and relies heavily on fossil fuels. In view of this landscape, a growing consensus is emerging that only a few energy sources can contribute to sustainable energy dynamics in the long-run. Fusion energy, fuelling the stars and the sun, is one of them. From lithium and water, which are low-priced and abundant, fusion technology aims at creating energy without generating greenhouse gases and long-lived radioactive waste.



The ITER experiment, widely acknowledged as one of the biggest international scientific projects ever, is hosted by the EU with strong commitments from the USA, Japan, Russia, China, India and South Korea. Europe participates in ITER through its European Atomic Energy Community, and is the largest investor in the project. Half the world's population may benefit from the results of this massive undertaking. Currently under construction in Cadarache, France, ITER aims at providing a significant contribution to the world's energy production in the next decades. Its success would trigger a future source of unlimited, sustainable and safe energy and open the door to the potential commercialization of fusion power plants.

The EU's fusion research programme is among the world leaders thanks to the experience and knowledge accumulated by the close cooperation between the national Fusion Laboratories over decades. A good example of this joint effort is the array of cutting-edge projects underway within the "Broader Approach" agreement signed in 2007 between Japan and the EU. Implemented by the Japan Atomic Energy Agency and the EU's Domestic Agency for ITER "Fusion for Energy", the Broader Approach provides major opportunities in a panoply of areas. The assembly of the "JT-60SA" Tokamak reactor, the kick-off of the "Helios" supercomputer last year and the progress with the prototype of the "IFMIF" accelerator-based neutron source are evident examples of this progress, which benefits science, engineering companies and manufacturing industries.

For industry, ITER sparks expertise on cutting-edge technologies for the future reactor and an occasion to develop commercial products in industrial areas outside fusion energy. This cross-fertilization drives scientific and technological progress and will be of significance in the coming decades as the fusion programme balances its science-driven and industry-driven approaches. Once the DEMO reactor proves its successful operation, industry will in fact have a unique chance to take full ownership of commercial fusion power plants.

This catalogue presents a selection of recent success stories by Spanish companies working actively in fusion. With a consolidated industrial sector in this field, Spanish companies are willing to play a major role in the future to push forward technological breakthroughs. But they are also engaged in using the resulting know-how to expand their business with a proactive attitude beyond the fusion sector, and with a clear international dimension.

We hope that scientists and companies will find this compendium useful and that many successful partnerships will be encouraged to successfully face the challenges and opportunities ahead of us in the field of fusion energy research.

Román Arjona
Secretary-General for Science, Technology and Innovation
President of the Spanish Innovation Agency (CDTI)



CIEMAT



Address: Av Complutense 40
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Web: www.ciemat.es

Contact person: Fernando Carbajo, *Fusion industry advisor*
+34 913 466 153
Fernando.carbajo@ciemat.es

Fusion activities:

Plasma physics:

- Stellarator physics: flexible heliac TJ-II,
- Role of magnetic topology
- Diagnostics development, in particular microwave and optical systems
- Low Z plasma wall physics: lithium coatings
- Turbulence & transport: role of zonal flows, transport of momentum, turbulence and rotation
- Advanced data processing: data mining, disruption and other event prediction
- Plasma theory: MHD, non diffusive transport, gyrokinetic modeling, physics of heating & CD
- Participation in the JET experiment: fast cameras, ECE diagnostic upgrade, disruption prevention, ELM physics.

Fusion Technology:

- Functional materials : optical elements, electrical insulators, cabling, RH components
- Structural materials : EUROFER, ODS steels , tungsten, SiC
- Neutron damage modeling,
- Breeding blankets: dual coolant technologies, liquid metals,
- Remote handling
- Neutronics and activation
- RAMI

Activities under the “Broader Approach to fusion” EU-Japan:

Participation on IFERC: SiC development)

Design and procurement of the JT60 Cryostat

Design and development of components for IFMIF

- IFMIF EVEDA accelerator components :

- RF system: 175 MHz 1MW
 - Beam dump
 - Beam diagnostics
 - Coupling section
 - High energy transmission line
 - Collaboration in the half wave resonator linacs
- Engineering for the IFMIF test cell
- Medium flux module design,
 - RH
 - RAMI
 - Neutronics.

IFMIF design integration

Awarded contracts and R&D projects:

F4E, ITER systems:

- design of plasma position reflectometer
- design of equatorial IR-Visible viewing system
- RH studies,
- NBI auxiliary systems
- Tritium modeling and experimental activities for TBM
- CODAC support

IO:

CODAC developments for ITER, engineering expert services

EFDA:

ITER activities:

- Diagnostics development for ITER
- Port plug design for ITER

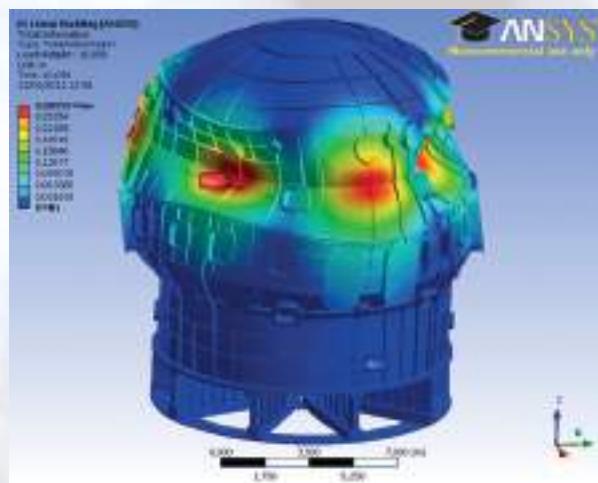
DEMO activities:

- Nneutronics,
- RAMI,
- Stellarator reactor options
- Breeding blankets
- Structural materials
- Design codes.



TJ-II stellarator

Structural analysis of the JT-60 cryostat: first buckling mode deformation



CDTI (CENTRE FOR THE DEVELOPMENT OF INDUSTRIAL TECHNOLOGY)



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28001 Madrid, SPAIN

Web:

Contact person: Belen del Cerro Gordo, *F4E Spanish ILO (Industrial Liaison Officer)*
+34 915 810 491
anabelen.delcerro@cdti.es

CDTI activities:

CDTI is a public entity, under the Spanish Ministry of Economy and Competitiveness, supporting industrial research and innovation of Spanish companies. Our main objectives are:

- To foster the Spanish industrial competitiveness by financing national R&D projects.
- To encourage the Spanish participation in international technological co-operation programs.
- To support technology transfer

CDTI promotes the participation of Spanish Industries in Large R&D Facilities such as ITER, CERN, ESRF, ESO, FAIR, XFEL, ILL. CDTI is the "Industrial Liaison Officer" (ILO) for all of them. In relation to F4E, the ILOs network acts as an exchange information forum for matters concerning the F4E industrial policy and related subjects. The network aims at:

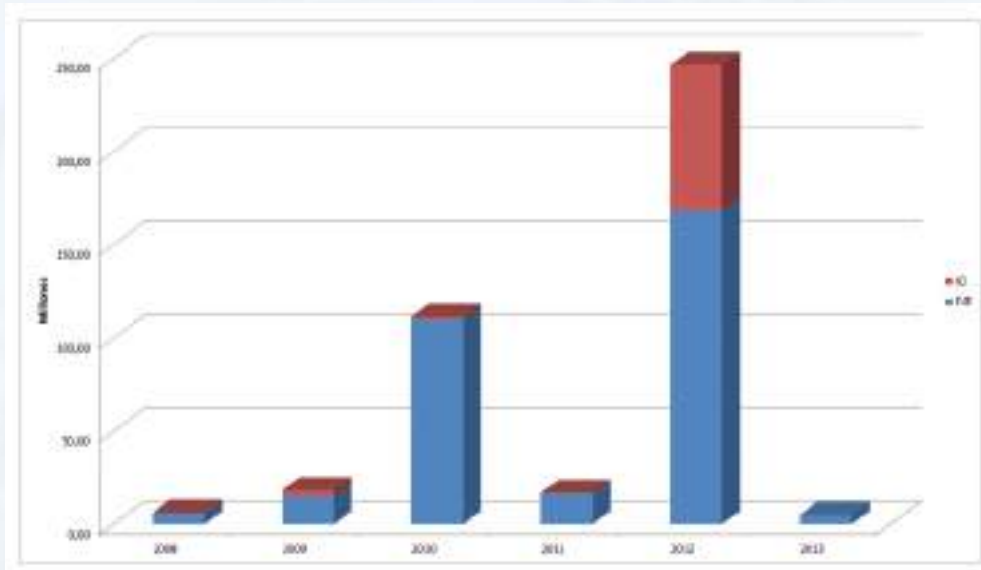
- Raising awareness and informing potential contractors about forthcoming call for tenders to be launched by F4E or ITER and working programs.
- Assisting potential contractors in their understanding of the technical, contractual and financial requirements of F4E within the frame of the above-mentioned calls.
- Enhancing partnership and networking activities.
- Supporting F4E in the preparation of capacities mapping and fostering the registration of European potential contractors in the F4E database.
- Encouraging the long-term participation of industry in fusion in view of realizing DEMO.

Spanish companies:

Since 2008, Spanish companies have increased the number and volume of contract awards in ITER. The peak was reached in 2012 with contracts worth more than 200 M€. So far, the Spanish industry has won more than 400 M€ in contracts for the construction of the ITER fusion project in a highly competitive market. As a result, Spain is currently the third country in ranking (behind France and Italy) of contracts managed by F4E. In addition, there are presently a lot of Spanish companies involved in on-going procurement processes and pre-qualifications.

Our industrial capabilities cover a wide range of technological areas, from mechanical - electrical engineering and civil engineering to assembly, electronics, cryogenics and vacuum systems, robotics, advanced materials, control systems and power supplies and they are present in many ITER components such as the vacuum vessel, magnets, buildings, test blankets modules, plant systems, remote handling, safety, I&C and CODAC, vessel components, to name but a few.

Spanish companies have also won important contracts in other fusion facilities such as JET, TJ-II, and they are currently participating in the Broader Approach projects JT-60 and IFMIF.



Spanish F&E & IO awarded contracts

ITER project faces significant challenges where Spain industry wants to play a major role promoting the collaboration at European and international level and exploring technological-scientific synergies that provide solutions of high added value.



Main Spanish awarded contracts in fusion



SPANISH ACTIVITIES



IDESA (INGENIERÍA Y DISEÑO EUROPEO, S.A.)



Address: C/Profesor Potter, 105
33203 Gijón (Asturias), SPAIN

Web: www.idesa.net

Turnover: 63 M€ in year 2012

Contact person: Iván Vázquez, *Business Development*
+34 985 175 705
ivan.vazquez@idesa.net

Fusion activities:

IDESA is a Spanish company located in Asturias (Northern coast of Spain), created in 1993. The company has grown to become one of the most recognized companies in the design and fabrication of static and modular equipment worldwide. IDESA is well positioned in the Oil and Gas sector, and has also recently started to operate in the Offshore Wind Farms and Industrial Plants sectors. Our production is 95% for export.

IDESA has capabilities with regard to Fusion activities in both engineering and fabrication fields, as can be found on the contracts listed below. We have mechanical design capabilities (including Finite Element Analysis) as well as drawing production (AutoCAD, SolidWorks). On the other hand, we can roll plates up to 180 mm, weld more than 200 mm in thickness (different materials: carbon, stainless, low alloy, clad steels, exotic alloys) and fabricate equipment weighing more than 1000 ton.

IDESA is interested in collaborations with regard to Fusion covering all our capabilities as mentioned above.

Awarded contracts and R&D projects:

FUSION MAIN CONTRACTS AWARDED AND R&D PROJECTS:

A) MANUFACTURING OF THE CRYOSTAT BASE FOR JT-60SA PROJECT

In the context of JT-60SA Project currently being developed in Naka (Japan), IDESA was awarded with the contract for the fabrication and shop assembly of the Cryostat Base. This structure, weighing around 300 ton and with a diameter of 12 meters, is an assembly comprising seven big stainless steel sectors, that are to be bolted together during final assembly in Japan. There are three "lower level" 120° sectors (the Lower Structure sectors), and three "upper level" 120° sectors (the Double Ring sectors) resting on the Lower Structure Sectors. The seventh piece is the Cylindrical Shell, located inside the DR sectors, and resting onto the LS sectors. This solution was adopted in view of the dimensional restrictions to the final land transport between Hitachi Port and final destination at Naka site.

The Lower Structure sectors are comprising three big beams each (thus, nine beams in total) which are resting on the beam ends via two support rings (inner and outer).

The Double Ring Sectors are made up of two big horizontal plates with a number of big formed gussets in between. They are staggered with respect to the LS sectors.

The Cylindrical Shell is a cylinder welded to a flat bottom, which rests directly onto LS beams, and will be welded at site to the DR inner edges.

The number of bolts used to bolt together the seven parts is around 600, in sizes up to M64.

The thicknesses of the structure are mostly between 80 and 100 mm. Most of welds are butt or corner welds, full penetration type, so a great amount of weldment is involved. Thus, the control of the distortion produced during welding activities was essential to fabricate a welded structure that at a later stage can be machined within the required tolerances.

The contract included a shop assembly of the seven sectors to validate the fabrication and the final dimensions of each of the sectors.

The material was delivered at Avilés Port (Spain) in November, 2012. After a two-months travel, it arrived at Hitachi Port in Japan by middle January, 2013. The final assembly at Naka site has already started.

B) REVISION AND UPDATE OF SDC-IC CODE FOR ITER PROJECT

Several ITER components, referred to as In-vessel Components, are located inside the ITER Vacuum Vessel; they will be subjected to special operating and environmental conditions (neutron radiation, high heat fluxes, electromagnetic forces, etc.). The effects of irradiation on them, including embrittlement, swelling and creep, are not addressed in the existing commercial codes. These conditions are different from conditions in fission reactors and create challenging issues related to the design of these components. For this reason the Structural Design Criteria for ITER In-vessel Components (SDC-IC) was developed in 2001 for design purposes.

In 2008, some issues were identified with regard to the existing version of SDC-IC:

- (1) Some parts had not been fully prepared to cover all needed areas for design
- (2) Some important topics needed to be improved
- (3) New editions of codes on pressure equipment had been published
- (4) No manufacturing rules were included, so consistency between manufacturing rules to be used and design rules in SDC-IC needed to be demonstrated
- (5) Compliance with the ESP (French Decree concerning the Pressure Equipment Directive 97/23/EC for non-nuclear pressure vessels) and ESPN (French Order applicable for pressure vessels intended for nuclear facilities) needed to be addressed

The Contract was awarded by Fusion For Energy (European Union's Joint Undertaking for ITER) to the consortia between Idesa and Natec and the tasks covered are:

- (a) Modification of design rules, incorporating rules from recently developed codes, and development of specific design rules to cover ITER specific issues and operational conditions
- (b) Demonstration of consistency between design rules in SDC-IC and european standards used for manufacturing, in particular EN 13445; identifying areas where consistency is not provided
- (c) Assessment of the compliance with the Essential Safety Requirements of the French Regulations (ESP and ESPN)



Cryostat Base



Assembly of Cryostat Base

INDRA SISTEMAS, S.A.



| | |
|------------------------|--|
| Address: | Avda. de Bruselas, 35 28108 Alcobendas (Madrid), SPAIN |
| Web: | http://www.indracompany.com/ |
| Turnover: | 2,688 M€ in year 2011 |
| Contact person: | Fernando Sastre Beceiro, <i>Energy Control Systems Director</i> +34 914 809 109 fsastre@indra.es |

Fusion activities:

Indra is a global company, leader in high value-added solutions and services based on TECHNOLOGY, finding innovative solutions to the challenges that clients face as: Energy Control Systems, Air Traffic Management, Simulators, Automatic Tests Systems, Radar or Viewing Systems. Company's Skills applicable to Fusion sector:

- Energy Technologies: Control technologies (I&C, SCADA, Data Acquisition,...), Metering systems, Modelization & Monitoring applications, Technical consultancy
- Space Technologies: Digital signal processing, Radio frequency, IP protocols and multimedia, Real-time, critical and embedded SW & HW, big DB, ...
- Simulation & Test Facilities
- Cross-Sectors Technologies: HW / FW Design, Critical SW Design, RF & Microwave Design, Electrical, Mechanical & Test Engineering, Electro-Optics,...

Company's Interest Areas in Fusion Programmes:

The interest areas of Indra in the field of big international Fusion projects are: I&C, Control Systems (Plant Control, CODAC, etc.), Diagnostics, Remote Handling, Remote Participation in experiments and General IT Support (corporate and business processes).

Awarded contracts and R&D projects:

F4E-2008-ADM/IT-05. "SPECIALIST IT SUPPORT SERVICES TO FUSION FOR ENERGY":

"Framework Contract in Cascade". Tender in 2008. Under execution from 2009. It consists in a Framework Contract in Cascade for Support service to F4E in the field of Information Technologies. It includes services of Infrastructure and System Administration Support, including profiles as: System Administrator Windows, System Administrator LINUX/UNIX, Microsoft Exchange 2007 Administrator, Workstation Administrator, DB (Oracle, SQL) Administrators, Helpdesk Support, etc.

F4E-OFC-169 (PS-IC) "FRAMEWORK SERVICE CONTRACT FOR PROVISION OF SYSTEM AND INSTRUMENTATION ENGINEERING SUPPORT":

Tender in 2010-2011. Under execution from September 2011. Duration 4 years. Is a Framework Contract for Engineering Support service to F4E in the field of Instrumentation and Control Systems engineering.

The services are rendered in two different schemas: In-sourcing, when the professionals on Indra and Associates are located in F4E premises, and Out-sourcing, when the services are executed from the contractors' offices.

These services include client support in their activities related to CODAC and I&C systems. Also covers maintaining a technical knowledge base to support F4E TROs and suppliers on CODAC technologies and standards, in special on CODAC Core System and Plant Control Design Handbook (ITER - PDCH).

CIEMAT Exp. 241.286: Manufacturing and supply of the RF Subsystem for IFMIF-EVEDA Lipac Accelerator:

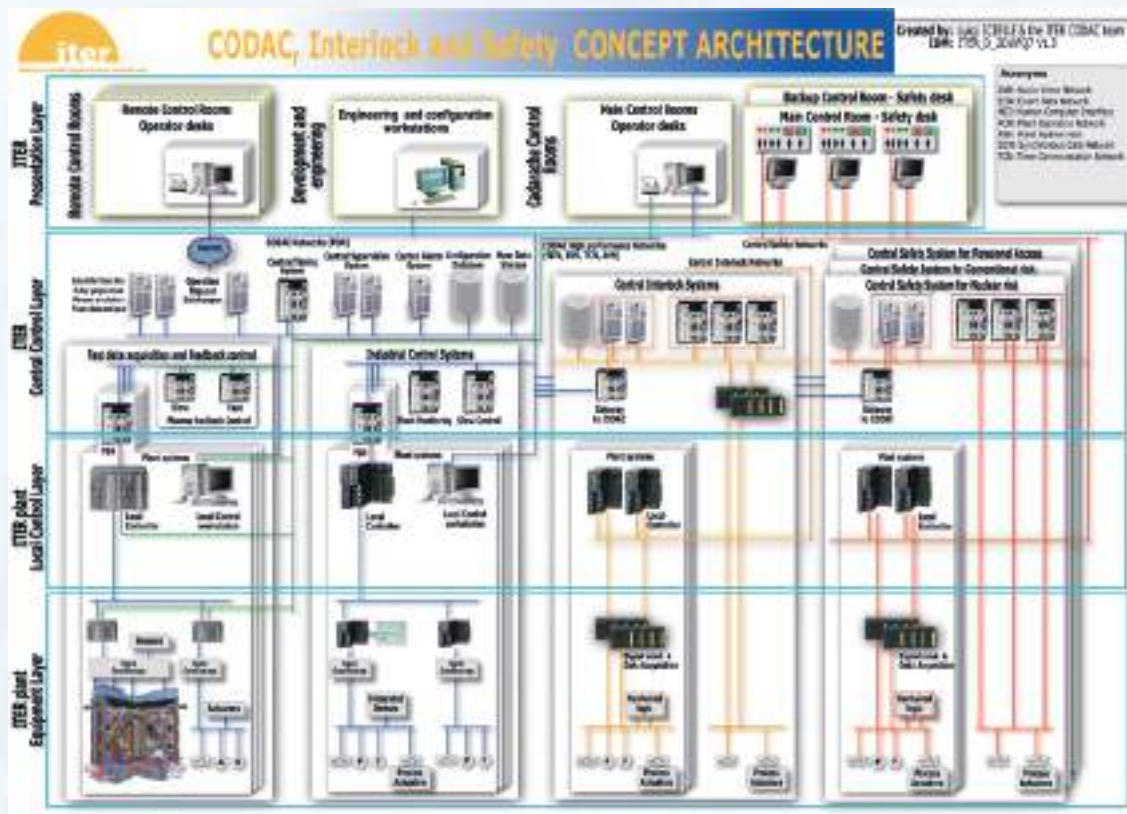
Includes Supply, Installation, and Support of:

16 RF Power Chains (ie. 8 x 105kW & 8 x 200kW) at 175Mhz, including RF Coaxial Lines and Low Voltage Distribution and Control.

Integration and commissioning laboratory for the RF Amplifiers and Conditioning of the RF Couplers

RF System EPICS based Local Control and Cooling Control Systems

All the control systems are based in Simatic S7-300 series PLCs and the control SW is developed under EPICS.

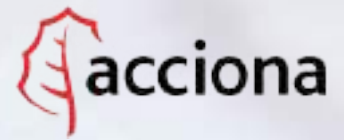


CODAC architecture



IFMIF RF Subsystem

ACCIONA



| | |
|------------------------|---|
| Address: | Avenida de Europea 18 28108 Alcobendas (Madrid), SPAIN |
| Web: | www.acciona.com/ |
| Turnover: | 6,646 M€ in year 2011 |
| Contact person: | Miguel Díaz-Llanos Ros, <i>Nuclear Division Director</i> +34 916 633 022/+34 600 505 621 miguel.diazllanos.ros@acciona.es |

Fusion activities:

ACCIONA is one of the foremost Spanish business corporations, leader in the development and management of infrastructure, renewable energy, water and services. ACCIONA is nowadays involved in several ITER tender and prequalification processes.

Awarded contracts and R&D projects:

ACCIONA has been prequalified for:

TB03: Civil Engineering and finishing works for Tokamak Complex, assembly hall and surrounding buildings including design, manufacture and installation of heavy nuclear doors (2011).

TB05: Design & Build for Magnet Power Conversion Bldg. & Reactive Power Control Bldg. Nowadays working in this tender (2012-2013).

Extension of the ITER Headquarters Building. Nowadays working in this tender (2013).

ACCIONA is pending of the following prequalification processes resolutions:

TB06: External Power Supplies Equipment & Installation (2012).

TB07: Design & Build for Cold Basin & Cooling Towers, Pumping Stations 6 Heat Exchangers (2012).

Moreover, ACCIONA has carried out an intensive program of R&D activities in the field of nuclear fusion in the recent years, which is supported by the fact that CDTI has awarded financial grants, through different funding programs, for several of such projects/initiatives:

Funding Programme: Programa Nacional del Espacio (CDTI)

Project Acronym/Title: NAHRIF / New applications of reinforced concretes for nuclear fusion installations (2007-2009) Project Budget: 614.000 €(CDTI contribution = 307.000 €)

Funding Programme: Subprograma de Apoyo a la Industria de la Ciencia (CDTI)

Project Acronym/Title: CUBICOM / Technical and economic feasibility study about the application of fibre-reinforced polymers (FRP) at the covering structure of the TOKAMAK building (ITER) (2010-2011)

Project Budget: 178.000 €(CDTI contribution = 129.000 €)

Collaborative project carried out in cooperation with CIEMAT

ACCIONA is also an active member of the existing national initiatives and technological platforms relevant to the nuclear sector (PTF, INEUSTAR and CEIDEN).



ITER project site

APPLUS LABORATORIES



Address: Ctra. Acceso Facultad de Medicina - Campos UAB
08193 Bellaterra (Barcelona), SPAIN

Web: www.appluslaboratories.com/es/

Turnover: 57 M€ in year 2012

Contact person: Blanca Monteagudo Mezo, *Business Development Energy*
0034 650 65 81 84
blanca.monteagudo@applus.com

Fusion activities:

Applus+ Laboratories specializes in developing technical solutions to enhance product competitiveness and faster innovation. Our experience in testing and our leading and recognized laboratories allow us to participate throughout the whole product value chain, offering testing, product development, quality control and certification services.

In Fusion, we principally aim to perform the following activities:

1. Engineering: we can apply our in-house knowledge and innovative technologies to design, develop and improve components, services or systems. One of our more demanded services is the design of test benches for complex and specific functionality tests.
2. Consultancy: our consultancy services are focus on the development of high quality product, pushing innovation by applying latest technology.
3. Testing: in Applus + modern laboratories, we can carry out the testing and analysis of components and systems which will constitute the fusion facility, by using the most appropriate equipment and instrumentation. Based on the results obtained, Applus+ will help the corresponding manufacturers to achieve compliance with the strict quality and safety requirements applicable.

Awarded contracts and R&D projects:

APPLUS+ Laboratories has been awarded with the "Competitive Multiple Framework Service Contract" (F4E-OMF-357 Provision of CAD Design Support).



APPLUS Laboratories in Bellaterra, Spain.

ASTRIUM CASA ESPACIO



Address: Avd. Aragón,40
Madrid (SPAIN)

Web: www.eads.net

Turnover: 100 M€ in year 2012

Contact person: José Guillamon, *Commercial Director*
+ 34 915 857 927
Jose.guillamon@astrium.eads.net

Fusion activities:

Astrium CASA Espacio is the Spanish leading company in the Space Sector. Its capabilities go from the System level activities (Prime contractor of the new generation of Spanish satellites) to the design, manufacturing and testing space structures (both satellites and launch vehicles). For fusion activities, CASA capabilities cover the areas of high scale structures made in composite materials, thermal control in vacuum conditions, harness and Radio-frequency. CASA is willing to export to ITER all these background acquired in the space sector, taking into account the similar boundary conditions of both systems (vacuum, cryogenic environment, etc.).

Awarded contracts and R&D projects:

Design development and qualification of the ITER Pre-compression rings. These rings are made in glass fiber and their design and manufacturing is a very challenging due to their big size and requirements.



AVS (ADDED VALUE SOLUTIONS)



Address: Xixilion 2 bajo, Pabellón 10
20870 Elgóibar (Guipúzcoa), SPAIN

Web: www.a-v-s.es

Turnover: 3M€ in year 2012

Contact person: Miguel Angel Carrera, *General Manager*
+34 943 821 841
macarrera@a-v-s.es

Fusion activities:

AVS' personnel has relevant experience in the following fusion activities:

Charge Exchange Recombination Spectroscopy (CXRS) based on a Diagnostic Neutral Beam Injector (DNBI)

Visible and VUV spectroscopy Beam Emission Spectroscopy (BES) Visible and IR camera diagnostics

Bolometers (X-ray monitors)

Charge Exchange Neutral Particle Analyzers (CX-NPA)

Beam diagnostics

Awarded contracts and R&D projects:

Design of the transverse halo monitor for the Linear IFMIF Prototype Accelerator, LIPAC.

Design, manufacturing and supply of the scrappers in the MEBT for the Linear IFMIF Prototype Accelerator LIPAC.

Design of the scrappers for IFMIF.



SCRAPPERS LIPAC

COMSA EMTE



| | |
|------------------------|---|
| Address: | Viriato, 47 08014 Barcelona, SPAIN |
| Web: | www.comsaemte.com |
| Turnover: | 2,158 M€ in year 2011 |
| Contact person: | Guillermo Barba, <i>Project Director</i> +34 933 662 100 gbarba@comsaemte.com |

Fusion activities:

COMSA, construction company in the COMSA EMTE group, is developing the infrastructure and civil works surrounding Fusion Buildings. The extensive experience and the high degree of specialization have consolidated COMSA as a major partner of F4E, implementing three urban development projects for it on the Cadarache platform.

Awarded contracts and R&D projects:

ITER-TB01: SITE ADAPTATION WORKS: Construction of deep drainage system, temporary worksite power supply, outdoor lighting and roads. Design and construction of a Contractors Area (CA2) with all networks (drainage, power supply, potable water, telecom) and facilities (Canteen for 1.500 workers, 500 m2 Offices, Infirmary) including a parking for 555 vehicles and a bus area.

ITER-TBAP: Construction of the ancillary galleries around the TOKAMAK pit. In these galleries will be placed all facilities needed for the operation of the TOKAMAK.

ITER-TB08: Design and construction of service trenches, service networks, service roads and parts of the Site General Infrastructures to be implemented on the ITER. The scope is the construction of the following networks: Industrial water drainage, sanitary drainage, outdoor lighting, precipitation drainage, roads, parking and lay down areas (including fences and gates of general or specific zones), special foundations, services trenches, buried trenches and backfilling for: Potable Water, Fire Water, Hot Water, Cooling Water, Chilled Water System, Heat Rejection System buried network and Integrated plant earthing grid.



Site Adaptation Works: trenches



Site Adaptation Works: canteen

ELYTT ENERGY



Address: Paseo de la Castellana 114, 3, 7
Madrid, SPAIN

Web: www.elytt.com

Turnover: 3 M€ in year 2012

Contact person: Angel Garcia-Franco, *Sales Manager*
+34 619 039 199
angel.garcia@elytt.com

Fusion activities:

Design of fusion reactor structural systems, design of superconducting magnets for material characterization, design of TF and PF coils (2D and 3D FEM and analytical electromagnetic calculations. 2D and 3D FEM and analytical stress calculations. 2D and 3D FEM and analytical thermal calculations. Support frame calculations)

Manufacturing of Superconducting Coils.

Awarded contracts and R&D projects:

1. Manufacturing of 10 Superconducting Toroidal Field coils for ITER/F4E in consortium with Iberdrola (Spain) and ASG (Italy). Elytt scope,
 - Conductor insulation
 - Manufacturing Process
 - Tool calculation and design
 - Tool manufacturing.
 - Tool qualification
 - Coil prototype manufacturing leading for conductor insulation
 - Double Pancake Vacuum Pressure Impregnation
 - Manufacturing Process Definition
 - Tool calculation and design. Tool manufacturing.
 - Coil prototype manufacturing leading for dp vpi
2. TF Coil Terminal Region Design and Analysis for ITER.
 - Study of the loads of the joint region during normal operation conditions.
3. TF conductor case specification for ITER. Review and update the specification of austenitic steel forgings and plates, the specification of welding and the specification of non destructive testing. Review and update the design description of the TF Coil Structures.
4. Mechanical engineering for ITER/EFDA: 28.800 engineering hours & 28.800 CAD hours. TF superconducting coils, PF superconducting coils, Design of TF coil without radial plate. TF superconducting coils, PF superconducting coils, Precompression ring, Manufacturing QA definition
5. Design of MRID (Magnetic Residual Ion Dump) for the NBI (Neutral Beam Injector) for EFDA. Non planar racetrack coil solution. Planar racetrack with CICC (cable in conduit) solution.
6. Blanket attachment design. EFDA/ITER

EMPRESARIOS AGRUPADOS INTERNACIONAL, S.A.



Address: Calle Magallanes, 3
28015 Madrid (SPAIN)

Web: www.empre.es

Turnover: 37.89 M€ in year 2012 (provisional)

Contact person: María Teresa Domínguez Bautista, *Advanced Projects Director*
+34 913 098 022
mdb@empre.es

Fusion activities:

Empresarios Agrupados Internacional, S.A. (EAI) has been participating in the European fusion programme since 1994 as a partner in the EFET consortium (European Fusion Engineering Technology). This consortium was awarded the contract with the European Union under the 5th and 6th Framework Programmes for the development of the design of the ITER facility IFMIF and other projects.

Following completion of the design phase, and after the construction of ITER was approved in November 2006, EAI was chosen and awarded the first contract for the construction of the PF (Poloidal Field) Coil Building. In 2010, in consortium with two French and a British company, EAI was awarded the Architect-Engineer contract for the construction of the 36 ITER buildings and the design of the electrical power distribution systems and the electromagnet power supply system. EAI is now actively pursuing further opportunities to collaborate in ITER, IFMIF and DEMO.

Awarded contracts and R&D projects:

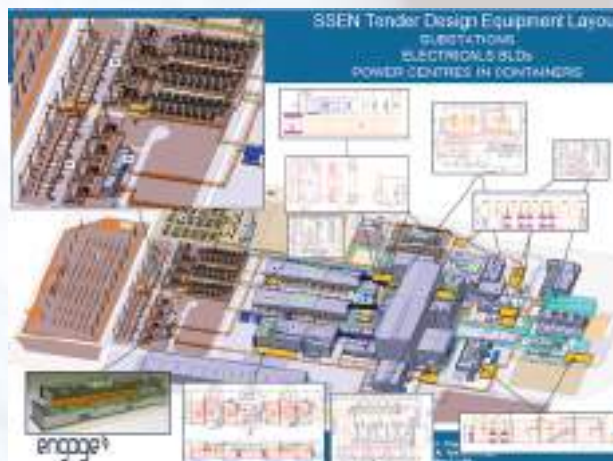
F4E-2009-OPE-020 (SB.PS): Support in tendering the Design and Build (DB) Contract, Safety and Health Protection Coordination (SHPC) contract, Legal Inspection (LI) contract and Support to the Owner (SO) contract for the ITER PF coil fabrication building

F4E-2009-OPE-058 (SB-PS): Architect Engineer Contract for ITER Buildings and Civil Infrastructures

GRANT F4E-2010-GRT-254 (PNS-TBM): "Tritium Migration Modelling and Conceptual Design of the Tritium Accountancy Systems for the European Test Blanket Systems" (Actions I & II)

CIEMAT contract: "Servicio para el diseño detallado del sistema de refrigeración por agua para el sistema de radiofrecuencia de IFMIF-EVEDA"

F4E-OPE-0465: Independent Review of Vacuum Vessel Finite Element Analyses (in progress)



Architect Engineer: SSEN
Equipment Layout

EQUIPOS NUCLEARES, S.L. (ENSA)



Address: José Ortega y Gasset 20, 5^º
28006 Madrid, SPAIN

Web: www.ensa.es

Turnover: 98.2 M€ in year 2012

Contact person: Francisco J. Adam Fernández, *Nuclear Business Marketing & Contracts*
+34 942 200 174
adam.fran@ensa.es

Fusion activities:

1. Ensa is an experienced supplier of services and equipment for the international nuclear market since almost 40 years. Its portfolio includes engineering, design, licensing, manufacturing, testing, etc. services and a complete range of activities in support of nuclear power plants.
2. All capabilities developed for the fission field are subject to be transferred to the fusion field such as manufacturing techniques, welding processes, inspection procedures, special tooling design, etc.
3. Ensa is mainly interested in the supply of large components to be manufactured or assembled as per strict nuclear standards and regulations.

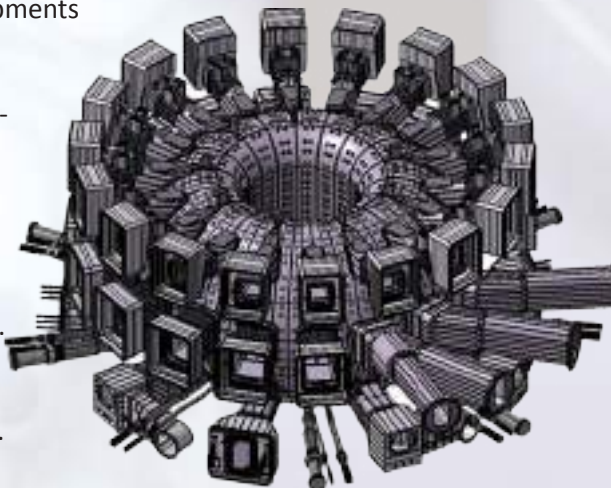
Awarded contracts and R&D projects:

2008 Year: Advanced Distortion Simulation Techniques during the manufacturing of structures for large plants. Development of a reliable technique for the prediction of distortion in large precision structures for the nuclear fusion investigation and to extend obtained results to other fields. The extremely strict tolerances require innovative control processes during the fabrication of the components, in particular, the Vacuum Vessel Sectors.

2007 Year: Feasibility Study for the development and manufacturing of European test modules for ITER project (EU-TBM). The target of this project was to anticipate the needs and capabilities of the Spanish industry in order to successfully face the EU ITER-TBM project through a technical analysis.

2007 Year: Feasibility Study for the Vacuum Vessel ITER project (EU-TBM). Feasibility study of the potential developments to be carried out and needed by Ensa during its expected involvement on ITER project. These technical developments were focused on the Vacuum Vessel Sectors fabrication, mainly on areas as manufacturing sequence, welding processes, testing procedures and tooling and first of a kind manufacturing devices.

2012 Year: Contract for the Assembly of the Vacuum Vessel. The scope of this contract awarded in 2012 by ITER Organization is the assembly at site of the Vacuum Vessel Sectors. This work required the development of many qualifications, processes (welding, control, testing, etc.) and associated devices and tools.



Iter Vacuum Vessel and port plugs

FERROVIAL

ferrovial

Address: Ribera del Loira, 42
28042 Madrid, SPAIN

Web: www.ferrovial.com

Turnover: 7,686.4 M€ in year 2012

Contact person: Alfonso Balasch, *Industrial Construction Division*
+34 913 008 905
abc@ferrovial.com

Fusion activities:

Ferrovial Group is one of the world's leading infrastructure companies, with an average of 69.000 employees during 2011 and operations in five continents in a range of sectors including construction, industry, airports, toll road and facilities management . Ferrovial Agroman is the Group Ferrovial's Construction Branch. With an amount of turnover 4.325,6 M€ in year 2012 representing 56% of the whole Group.

Concerning the ITER project, Ferrovial aims to offer its expertise in construction of large industrial facilities, as well as a deep knowledge of a wide range of civil works and M&E activities. The company has been involved in all major nuclear projects in Spain.

Awarded contracts and R&D projects:

Ferrovial Agroman, as member of a Consortium, has awarded in 2012 the contract for the construction of the Package TB03 Main Civil & Finishing Works in the ITER Complex Cadarache.



TB03 – Main Civil & Finishing Works

GAMCO S.L.



Address: C/ Alcalá 20
28014 Madrid, SPAIN

Web: www.gamco.es

Turnover: 250,542 € in year 2011

Contact person: Fernando Pavón Pérez, *CTO*
+34 677 514 616
Fernando Pavón Pérez

Fusion activities:

GAMCO provides corporate solutions by developing complex computer models for forecasting, classification and analysis. GAMCO also offers consultancy to support these implemented technologies and on-site training on software developed and techniques used.

GAMCO technology has next important characteristics: Self-learning, our models can refine themselves in an automated fashion using newly updated data. And "on-line", real-time model execution and update; new data can be simultaneously recorded and integrated.

GAMCO is working in Fusion with the "Laboratorio Nacional de Fusión por Confinamiento" a laboratory in CIEMAT which is focused in R&D activities for the development of magnetic fusion confinement.

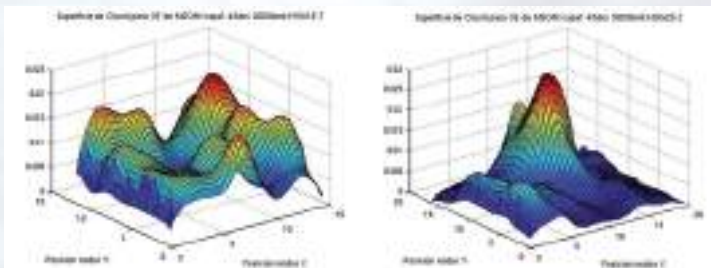
We are working with data from JET (Joint European Torus) making models for automatic discover different types of L-H and H-L transactions, discovering most important signals in these transactions and automatic discover when there are operations fails in the sensors.

Awarded contracts and R&D projects:

Since 2010 we are working in THEFUMO (Thermonuclear Fusion Modeling) project which has public funding from CDTI (Centro para el Desarrollo Tecnológico Industrial).

In this project we are developing advanced algorithms for self-learning, visualization and modelization from a huge amount of data providing from JET.

Our objective is developing real-time methods from automatic manage the signals and make predictive models. These models will be use for many different tasks: predictive maintenance, avoid ELMs, multi-signals analysis in L-H or H-L transitions, etc.



Instrumentation, control and diagnosis at the core of ITER.

GAS NATURAL FENOSA ENGINEERING S.L.U.

engineering



| | |
|------------------------|--|
| Address: | Acanto, 11 – 13 28045 Madrid, SPAIN |
| Web: | www.gasnaturalfenosa.com |
| Turnover: | 81,020 M€ (2009); 71,030 M€ (2010); 53,735 M€ (2011) |
| Contact person: | Soledad López Postiglione, <i>Directora Desarrollo de Negocio</i> +34 912 578 000 slpostiglione@gasnatural.com |

Fusion activities:

GNFE has finished the following activities related to fusion for F4E:

- TASK ORDER 1: “Cost Assessment of the ITER Cryoplant System. Evaluation of LN2 Plant Sizing and Rotating Machinery Options”, in cryogenics area, that consisted in a first analysis of rotating machinery, pre-selection of technologies and suppliers and a first layout of the “Cold Box” and costs breakdown.
- TASK ORDER 2: “Review of PCDH Criteria and its Impact on the Plant Control System Supplies”, in I&C area, including an analysis of the “Plant Control Design Handbook” and related documents; and the design and insertion of the whole contents of a Data Base with the Classification Criteria.
- TASK ORDER 3: “Industrial Cost Evaluation of the Cooling Plant for PRIMA (MITICA and SPIDER Experiments)”, in the cooling systems area, consisted in the development of a breakdown costs of the cooling plant for the experimental devices of PRIMA (MITICA and SPIDER).
- TASK ORDER 4: “ITER cryoplant 80 K loops. Compressor technology validation, sizing of the cold box components”, in the cryogenics area, consisted of the following activities: Cold Box definition, complete market survey for centrifugal compressors and full validation of the pre-selected compressors supplier.

Awarded contracts and R&D projects:

GNFE leads the Frame Contract F4E-2008-OPE-017-02-01, “Engineering Support to F4E – Plant Systems (Lot 2)”, which includes the plant engineering support to F4E in the fields of:

- Design of water cooling systems.
- Design of heating, ventilation and air conditioning.
- Design of cryoplant and cryodistribution systems and components.
- Design of vacuum system.
- Design of electrical systems, power converters, emergency power supply and high voltage AC distribution systems.
- Support to assembly, onsite installation and commissioning of the electrical systems and components.

GTD SISTEMAS DE INFORMACIÓN S.A.



Address: Pg. Garcia i Faria, 17
08005 Barcelona, SPAIN

Web: www.gtd.es

Turnover: 20.4 M€ in year 2011

Contact person: Javier Varas, *Deputy Director – Programs & Corporates*
+34 934 939 300
Javier.varas@gtd.es

Fusion activities:

GTD is a global technology company committed with the Design, Integration and Operation of high-value, complex, “mission-critical” Applications and Systems all over the world. Excellence in securing performance, availability and robustness makes GTD the ideal choice for strategic projects. The main activity sectors of GTD are Space, Aeronautics, Defense&Security and Complex Utilities, including scientific laboratories, with a long tradition in several facilities including CELLS-ALBA, ILL, ESRF and CERN.

In ITER Project, GTD is focusing efforts in “instrumentation and control activities”, where the company contributes with the consolidated experience in particle accelerators and cross domain knowledge conveyed from Aerospace industry.

In connection with the framework focus in “Instrumentation and Control”, GTD is specifically interested in: (1) the central control system (CODAC); (2) the complex operational diagnosis and its related big data analytics; and (3) the implementation of ITER control room.

Awarded contracts and R&D projects:

Framework contract for the provision of instrumentation and control integration services (F4E-OFC-361): These services will range from the implementation of the interface between industrial supplied systems and ITER CODAC (Control Data Access Communication), to the development of the complete control systems of a plant.



ITER Project

IBERDROLA INGENIERÍA Y CONSTRUCCIÓN, SAU



Address: Avenida de Manoteras, 20
28050 Madrid, SPAIN

Web: www.iberdrolaingenieria.com

Turnover: 723.87 M€ in year 2012

Contact person: Enrique CAYETANO, *Nuclear Business Development Manager*
+34 917 132 021
ecrr@iberdrola.es

Fusion activities:

GENERAL: Owner's Engineering, Mechanical, Electrical and I&C Engineering, Safety&License, Waste Treatment, Radiological Protection, Procurement and Construction, Maintenance, Services

ISO 9001, ISO 14001, ASME, RCC-MR, CEFRI, IAEA

FUSION: Design, Manufacturing, R&D, Assembly, Maintenance, Service, Control

ITER: Magnets, Vacuum Vessel, Remote Handling, Diagnostics, Buildings, CODAC, CIS, Power Supply, Cooling System, Vacuum Pumping, Auxiliary Systems

Awarded contracts and R&D projects:

ITER both Electrical and Mechanical/Components Engineering, Safety and License Engineering, Mechanical analysis for the Vacuum Vessel

Supply contract for Toroidal Field coil winding packs

Fabrication of a standard semi-prototype of the ITER NHF First Wall Panel



Winding line of TF Coils

IDOM



| | |
|------------------------|--|
| Address: | Av. Zarandoa, 23 48015 Bilbao (Vizcaya), SPAIN |
| Web: | www.idom.com |
| Turnover: | IDOM (GROUP) 300 M€ in year 2011 |
| Contact person: | Miguel Navarro Larrauri, <i>Director of Nuclear Services Area</i> +34 944 797 600 nuclear@idom.com |

Fusion activities:

Idom, alongside the engineers from Halcrow and Altran (i.e., ENERGHIA Consortium) is providing technical support to the ITER project in the role of "Support to the Owner" for the management of infrastructure civil works, electrical and mechanical installations and the overall coordination of these disciplines.

Idom is working on the analysis of the overall performance of the Tokamak reactor and its coupling with the main structure of the building, studying protections against accidental dynamic loads of seismic and electromagnetic nature.

Idom is also participating in the development of the two European Test Blanket Module concepts, originally designed by CEA and KIT. The feasibility of different alternatives is also being studied, encompassing a global approach using advanced simulation tools (e.g., FEM, CFD, Monte Carlo).

Concerning the control of the tritium leakage, Idom has conducted different simulations to analyze the temporal evolution of the concentration of the radioactive gas and optimize the detection system for each room, minimizing the detection time.

In the field of Cryogenics, Idom is responsible for designing the main components of the cryopumps cryodistribution (e.g., cold valve boxes, warm regeneration system, control valves).

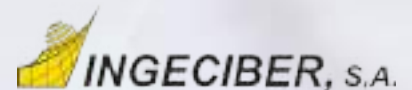
Awarded contracts and R&D projects:

- F4E-2009-OPE-024 (SB-PS) General Support to the Owner Contract, as member of ENERGHIA.
- F4E-2009-OPE-074 Mechanical CAD support in the context of Vacuum Vessel Procurement.
- F4E-2008-OPE-011 Support in the area of civil engineering analysis. Lot 1: Seismic analyses.
- F4E-2008-OPE-011 Support in the area of civil engineering analysis. Lot 2: Effects of explosions and impacts.
- F4E-2008-OPE-011 Support in the area of civil engineering analysis. Lot 3: Structural analysis of ITER Buildings.
- F4E-GRT-288 Study of three design configurations for HCLL and HCPB TBM.
- F4E-OMF-331 Engineering support in the area of TBM systems design and technological demonstration. Lot 1: Design of TBM sets, analyses and design validation.
- F4E-2009-OPE-031 Framework Contract for Engineering Analysis in the area of Fluid dynamics Analysis. Lot 2: Fluid dynamics. Provision of Engineering Support to Develop Analysis in the Areas of Fluid Dynamics.
- F4E-2011-OPE-289 Update and Completion of the Design of the Front-end Cryopumps Cryodistribution.



Test Blanket Module

INGECIBER S.A.



Address: Avenida Monforte de Lemos 189
28035 Madrid, SPAIN

Web: www.ingeciber.com

Turnover: 1.76 M€ in year 2011

Contact person: Miguel Angel Moreno, *CEO*
+ 34 913 862 222
ma.moreno@ingeciber.com

Fusion activities:

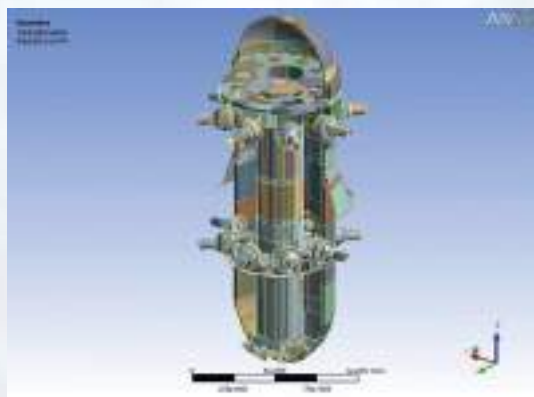
Company description: engineering company founded in 1986 specialized in Finite Element Methods and CAE simulation tools. We develop Engineering Consultancy Services, training services, CAE Software Distribution and Technical Support provider in the civil engineering, mechanical and CFD sectors.

Ingeciber has a Consultancy Engineering Department with over 25 year experience in the Nuclear Power sector. Additionally we have the hardware and software required to develop any simulation analysis using ANSYS, Nastran, Marc, CivilFEM, CFX, CFD++ and other software applications.

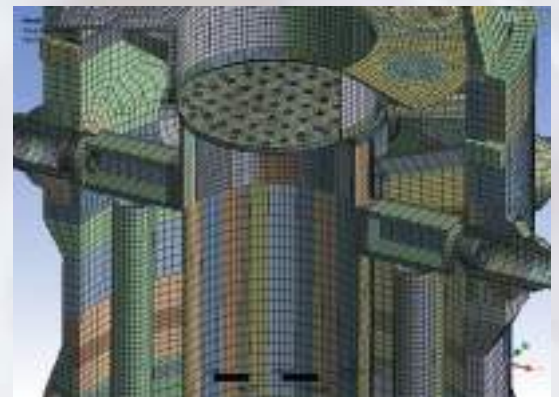
Since Ingeciber was founded we have always been present in most innovative ingeneering sectors. Our aims is to provide ITER/F4E with designing, checking and consultancy CAE.

Awarded contracts and R&D projects:

- 1. F4E main contract awarded:**
F4E- OMF – 356 Framework service Contract for the “Provision of Engineering Support in the field of Mechanical analysis for the Vacuum Vessel”. Awarded (IO Portal) October 2012.
- 2. “Modeling and design features for the seismic analysis of the IRIS vessel, core barrel and internals”.** ENSA, 2010. The main result of the non-linear dynamic analysis was the evaluation of the effects of including the isolator device on the seismic response of the reactor in addition to its compliance to applicable standards.
- 3. “Design and checking of structural elements of buildings of the Nuclear Plant type AP 1000”.** Westinghouse, 2011. Ingeciber did the structural analysis, checking & validation with ACI 349 and AISC NF 690 with ANSYS and CivilFEM Nuclear Power Plant module.



Geometry of New Reactor NPP



Mesh of New Reactor NPP

ITD (SERVICIOS DE INGENIERÍA Y TECNOLOGÍAS DE DISEÑO)



Address: Avenida Leonardo Da Vinci, 15
28906 Getafe (Madrid), SPAIN

Web: www.s-itd.es

Turnover: 11,8 M€ in year 2011

Contact person: Taha ALIARI, *Commercial Manager*
+34 651 702 908
taha.aliari@s-itd.es

Fusion activities:

ITD's expertise is largely related to aerospace programs, being one of the leading engineering companies in the Spanish industry. This expertise embraces most of the engineering and design technologies also applicable for the development of Fusion Activities.

As an engineering company specializing in Electrical & Mechanical Systems, Structural Design & Analysis and Instrumentation, our added value is based on our transnational management capabilities and our long experience in the development of international projects in highly technological environments.

ITD brings its best value to customers and partners in terms of cost-efficiency and quality assurance. Presently we are addressing this best value for ITER and CERN in the field of Design Services.

Awarded contracts and R&D projects:

Provision of Plant Systems support for: Industrial Cost Evaluation and Scheduling of the Cooling Plant for PRIMA (MITICA and SPIDER Experiments)

PRIMA is a test facility located in Padova (Italy) aiming at testing and qualifying at full scale the Heating and Current Drive Neutral Beam Injector before installation in the near-term International Thermonuclear Experimental Reactor (ITER) in Cadarache (France).

The subject of this Contract was the set of requirements for the design, manufacture, installation and testing of the Cooling Plant.



JEMA ENERGY S.A.



Address: Paseo del Circuito 10
20160 Lasarte-Oria (Gipuzkoa) SPAIN

Web: www.jemaenergy.com

Turnover: 19.54 M€ in year 2012

Contact person: Ibon Cerro, *Technical Area Manager*
+34 943 376 400
i.cerro@jema.es

Fusion activities:

For 60 years, Jema designs and manufactures Static Power Converters for different sectors, such as Power Plants, Oil & Gas, Plasma Physics, Particle Accelerators, Magnetic Resonance Imaginary (MRI), Railways and Renewable Energy. We are customer orientated, developing bespoke systems and solutions which meet specific requirements of each project. These are innovative solutions with high technological content. The company is part of Irizar Group (3500 employees and yearly turnover of 500 M€).

“Top level technology for Advanced Research installations”. Jema is the European leader supplying custom power converters systems for top level facilities.

“Innovative energy systems for unique applications”. These markets are featured by their exclusivity and high demands and challenges. Jema has to develop unique solutions; often in the limit of what can be achieved using today’s technology.

Over 20 years, JEMA Energy has developed several custom power supplies for most of the Experimental Fusion Reactors in Europe (MAST, JET, W7X, TJ-II, TCV, etc). As ITER is the next step in Fusion Reactors, JEMA is interested in continuing its commitment with the Fusion Community. More specifically, JEMA Energy is interested in developing of Power Supplies and systems for the ERC, NBI, TF & PF systems of ITER.

Awarded contracts and R&D projects:

CEA Saclay –Magnetic Resonance Imaginary (MRI): Magnet Power Supply

CCFE-UKAEA –(under development) Toroidal Field Power Supplies, 340Vdc, 133kA.

CCFE-UKAEA –Divertor Field Power Conversion Units, 700Vdc, 4 to 10 kA.

UKAEA –2010. NBI High Voltage Power Supplies for MAST project

EFDA-JET –2005 and 2002. ERFA (Enhanced Radial Field Amplifier): 4 Seriable Power Supplies

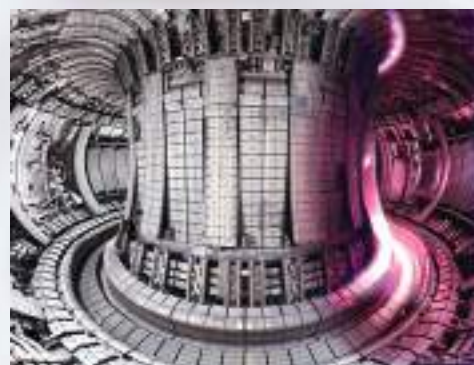
GSI –2007. Preliminary design of the dipole and the AMOS quadrupole Power Supply

CIEMAT – TJ-II (1991 -2006) HV PS for the ECRH system, NBI HVPS, Pulse Generator set...

IPP –W-7X 2000. 10 Control Coils Power Supplies



JEMA Facilities



JET

LEADING ENTERPRISES, S.L.



Address: Barrio la Agüera, s/n
39409 San Felices de Buelna (Cantabria), SPAIN

Web: www.leadingenterprises.es

Turnover: 25.2 M€ in year 2011 (LE Group)

Contact person: Marcos Pérez, *Technical & Business Development Director*
+34 610 261 493
mperez@leadingenterprises.es

Fusion activities:

OVERVIEW:

LE Group is formed by three fabrication companies (MIB: advanced machining; TAF: services for casting industries; TMT: tooling manufacturing), two engineering entities (EPS: Oil&Gas ; CT INNOVA: R&D) and three companies focused on industrial services (Leading Integra: SCM; SB: Industrial cleaning, CYDA: logistics).

FUSION CAPACITIES: Mechanical design with production of 3D models and 2D drawings, engineering simulation studies, machining simulation, welding simulation...

Components manufacturing, machining of complex components and additional operations (thermal treatments, welding technologies, assemblies...)

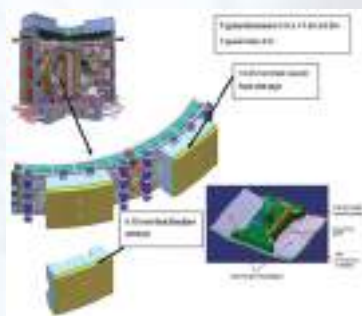
INTERESTS IN FUSION PROGRAM: the interests of LE Group companies are focused on engineering services and manufacturing of small and medium size components in the edge of technology.

Awarded contracts and R&D projects:

F4E-2008-OPE-017 (ES-AC) Lot 2: Plant engineering support in the fields of plant systems, in tasks as Design of systems; Support to assembly, on-site installation and commissioning of the electrical equipment and components; Support to factory or onsite testing of the equipment and to integrated system acceptance tests; elaboration of the as built documentation of the system; Plant system integration

ITER Blanket CDTI(2010): It's an applied research project for the development of the "First Wall Panels" of the New Nuclear Fusion Reactor ITER. Project led by MIB with the participation of CT INNOVA and other partners which is supported with public funding provided by a competitive program of CDTI.

F4E-OPE-394 (IV-PT): Fabrication of a standard semi-prototype of the ITER NHF First Wall Panels (FWP). Supply of one First wall panel semi-prototype as well as the related technology developments as required for the manufacture. The machined semi-prototype shall represent 6 complete fingers of the final FW panel and have Beryllium tiles joined onto the CuCrZr heat sink layer by Hot Isostatic Pressing (HIPping).



Conceptual view of the First Wall Panels

NUMERICAL ANALYSIS TECHNOLOGIES (NATEC)



Address: Marqués de San Esteban 52, Entlo D
33206 Gijón (Asturias), SPAIN

Web: www.natec-ingenieros.com

Turnover: 705,000 € in year 2012

Contact person: Javier Ordieres, *Organization Manager*
+34 984 199 692
javiord@natec-ingenieros.com

Fusion activities:

NATEC is an engineering company specialized in advanced analysis: nonlinear and coupled analysis in the mechanical and thermal fields. Main capabilities demonstrated in projects carried out in the framework of ITER are:

Structural integrity assessments according nuclear codes (RCC-MR, ASME and SDC-IC).

Mechanical design and engineering analysis of Fusion devices components (ITER):

Welding process simulation to predict distortions during the manufacturing of the ITER Vacuum Vessel, diagnostic port plugs and ITER Toroidal Field Coil Cases.

Awarded contracts and R&D projects:

PROCUREMENT FRAMEWORK CONTRACT F4E-2008-OPE-07(ES-AC): PROVISION OF ENGINEERING SUPPORT IN THE AREA OF MECHANICAL ANALYSIS. LOTE 1: VACUUM VESSEL ANALYSIS.

Mechanical, structural, thermo-mechanical and coupled analysis oriented to code.

GRANT F4E-2008-GRT-024 (PMS-DG): DETAILED DESIGN OF A REPRESENTATIVE EQUATORIAL PORT PLUG.

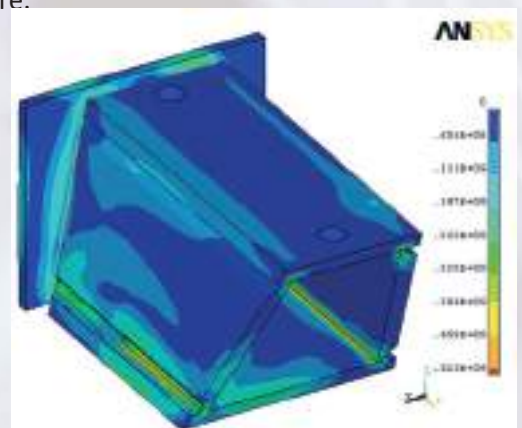
PROCUREMENT FRAMEWORK CONTRACT F4E-2008-OPE-017 (ES-AC): FRAMEWORK SERVICE CONTRACT FOR ENGINEERING SUPPORT TO F4E.

PROCUREMENT F4E-2009-OPE-033 (ES-AC): REVISION OF THE STRUCTURAL DESIGN CRITERIA FOR IN-VESSEL COMPONENTS (SDC-IC). The Structural Design Criteria for In-Vessels Components (SDC-IC) had to be reviewed in order to incorporate the modifications included in the last versions of nuclear pressure equipment codes as ASME, RCC-MX and RCC-MR.

PROCUREMENT F4E-2008-OPE-297 (ES-AC): TOROIDAL FIELD COIL CASE WELDING SIMULATION. This work was intended to simulate numerically the deformations/distortions induced in the TF coil structure by the closure welding procedure.

ITER/CT/10/4300000295: PROVISION OF MECHANICAL, THERMO-HYDRAULIC AND ELECTRO-MAGNETIC ANALYSIS OF ITER DIAGNOSTICS COMPONENTS. The analysis performed included TH, EM, Structural, Seismic and Modal, leading to a Transient Dynamic analysis under EM loads from a Plasma major Disruption event. All the analysis performed included besides the Port Plug: the Equatorial Port and a 40° portion of Poloidal Segment 3 of the Vacuum Vessel.

ITER/CT/12/4300000598: ENGINEERING SUPPORT FOR MECHANICAL, THERMO-HYDRAULIC AND ELECTRO-MAGNETIC ANALYSIS OF ITER DIAGNOSTICS COMPONENTS. Thermo-hydraulic and electro-magnetic analysis of ITER diagnostics components.



Numerical simulation carried out, using an internal development simulation tool, by Finite Element Analysis, created to predict distortions and residual stresses induced during real manufacturing welding process

PROCON SYSTEMS, S.A.



Address: Arquímedes 26
08918 Badalona (Barcelona), SPAIN

Web: www.proconsystems.net

Turnover: 6.6 M€ in year 2012

Contact person: Daniel Marchante, *Sales Manager*
+34 934 609 940
marchante@proconsystems.net

Fusion activities:

- Guidelines for the I&C cubicles hardware design that are included in plant control design handbook (PCDH).
- I&C hardware engineering.
- I&C software engineering.
- I&C cubicle fabrication.

Awarded contracts and R&D projects:

- Control system for the prototype cassette multifunctional mover (CMM), second cassette end effector (SCEE) and cassette toroidal mover (CTM) for divertor test platform(DTP2) A (2006-2007).
- Prototyping interlock control system for ITER (2010-2012).
- Defining internal configuration guidelines for I&C cubicles for ITER (2010-2012).



I&C Cabinets

SENER, INGENIERÍA Y SISTEMAS, S.A.



Address: Avda. Zugazarte, 56,
48930 Las Arenas (Vizcaya), SPAIN

Web: www.sener.es

Turnover: 653 M€ in year 2011

Contact person: M^a Rosa Sacristán Díaz, *Power and Process Business Unit Delegate*
+34 932 283 380
mrosa.sacristan@sener.es

Fusion activities:

- SENER Ingeniería y Sistemas, S.A. is an Engineering and Construction company backed by more than 50 years of experience. Innovation, commitment to quality and independence are our corporate values. International leader in Civil Engineering and Architecture, Aerospace Engineering, Aeronautics and Vehicles, Actuator and Control Systems, Power and Processes and Marine Engineering.
- Design and construction capability of complete facilities regarding all technical disciplines: process, mechanical, piping, civil and structures, instrumentation & control, HVAC systems, fire detection/protection. Possible project scopes: conceptual, basic and detail design and procurement and construction.
- SENER is interested in all packages that include engineering in fusion projects.

Awarded contracts and R&D projects:

TJ-II facility studies: Preliminary estimation of the cost of the TJ-II fusion machine and facility in 1985 for CIEMAT.

ITER Project: Robotics, Electrical engineering, Design of mechanical equipment for handling, lifting, maintaining, Civil, HVAC, Site validation studies, Cost studies, Several studies for DEMO alternatives as IBERTEF in the European Consortium EFET, between 1994 and 2004. For EURATOM-CIEMAT early studies which led to the preselection of the Vandellós site, Vandellós site validation studies, design of a special crane for the ITER NBI system, analysis for conceptual variants for the DEMO, etc.

In 2012-2013, Multiscale Finite Element analysis (FEM) for the Pre-compression Rings, directly for ITER: approach employing various scales of ABAQUS FEM models and other analysis tools to calculate the response and performance of the rings over the design life of the structure.

Fuskite: R&D project (CDTI) to develop a Permeator Against Vacuum Prototype to recover efficiently tritium, for fusion reactors self-sufficiency. Pre-conceptual design carried out by CIEMAT. SENER is responsible for the turnkey project including Conceptual and detailed design (Process, Structural, Mechanical, Instrumentation and Control and Electricity), Manufacturing, assembly and commissioning of the demonstrator (2011-ongoing).



Fuskite assembly process

SGENIA



Address: C/ Chile, nº 4, Edificio II, 2ª planta
28230 Las Rozas (Madrid), SPAIN

Web: www.sgenia.com

Turnover: 3 M€ in year 2012

Contact person: Ms. Gil, *Technology Responsible*
+34 916 306 388
igil@sgenia.com

Fusion activities:

- Sgenia, as an engineering company, can develop electro-mechanical, thermo-mechanical and electro-magnetic design, modeling and simulation, Finite Element Analysis (FEA) and Computational Fluids Dynamics (CFD) simulations.
- Sgenia is also specialised in automation and advanced control system (Remote-Handling field), State-of-the-art sensor systems (Diagnostics field), power electronics systems and industrial instrumentation equipment (Instrumentation&Control field).

Awarded contracts and R&D projects:

R&D project: A plasma tomographic reconstruction system based on a new superconductor and accurate sensor system together with Bayesian algorithm development.

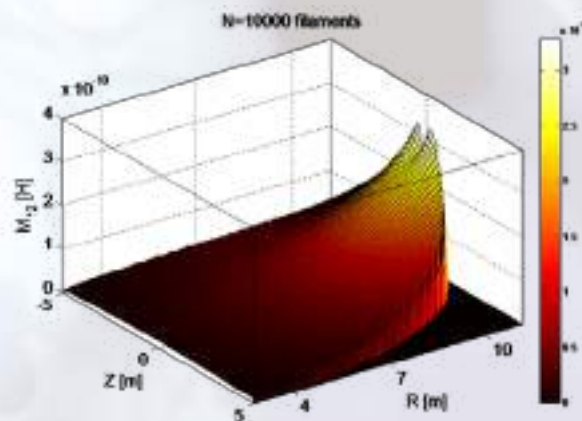
Contracts Awarded:

The consortium comprised of IPP (Institut für PlasmaPhysik) and Sgenia has been selected for the award of the tender F4E-FPA-364 (DG): Diagnostic Development and Design: Pressure Gauges.

Sgenia will be responsible of the following technical tasks:

- Conversion of CAD models of Diagnostic Pressure Gauges (DPG) from CATIA to a format suitable for ANSYS calculations.
- Mechanical, thermal, fluid and electromagnetic engineering analysis using static and dynamic FEA to applicable codes and standards of the DPGs.
The analysis will incorporate neutron and gamma radiation loads as given by IPP or other third party.
Exact boundary conditions for the calculations will be defined in the Kick-Off meeting for the FPA and within subsequent Specific Contracts.
- Optimization of ion gauge performance through simulations of electron and ion transport in the gauge head immersed in strong magnetic field including the interaction with neutral gas.

KIT jointly with the other members of the TBM-CA consortium and NRG have been awarded the three Actions of the tender **F4E-FPA-380. Regarding Action 2: Test Blanket System Instrumentation Development**, Sgenia, as a third party of Ciemat (Spain) will be in charge of feasibility studies for prototype development of EM sensors.



Mutual inductances between filaments representing the plasma current and the superconductor and accurate sensor proposed to measure of magnetic field

TECNALIA



Address: Parque Tecnológico de San Sebastián. Mikeletegui Paselekua
San Sebastián, SPAIN

Web: www.tecnalia.com

Turnover: 116 M€ in year 2011

Contact person: Iñaki Inzunza, *Industry of Science Programme Director*
+34 902 760 002
inaki.inzunza@tecnalia.com

Fusion activities:

Research & development:

- A. - Construction and environment.
- B. - Energy efficiency.
- C. - Advanced materials and processes.
- D. - Handling and services.
- E. - Tests and calibration.

Design support

Consultancy

Control

Awarded contracts and R&D projects:

- F4E-2008-OPE-017-02-01 (ES-AC) Lot 2 – Engineering Support in the area of Plant Systems.
- CDTI project. R&D Activities for ITER Blankets.(2010)
- F4E-OFC-167 (ES-MF) Material characterization at room at elevated temperatures
- F4E-FPA-380 “Activities of Support of the Conceptual and Preliminary Design of the European Test Blanket Systems”
- F4E-OPE-394 Fabrication of a standard semi-prototype of the ITER NHF First Wall (FW) panels



F4E-OFC-167 Kick off meeting

TECNATOM, S.A.



Address: Avenida Montes de Oca, 1
28703 San Sebastián de los Reyes (Madrid), SPAIN

Web: www.tecnatom.es

Turnover: 115.12 M€ in year 2012

Contact person: Rafael Martínez-Oña, *Senior Manager*
+34 916 598 657
rmo@tecnatom.es

Fusion activities:

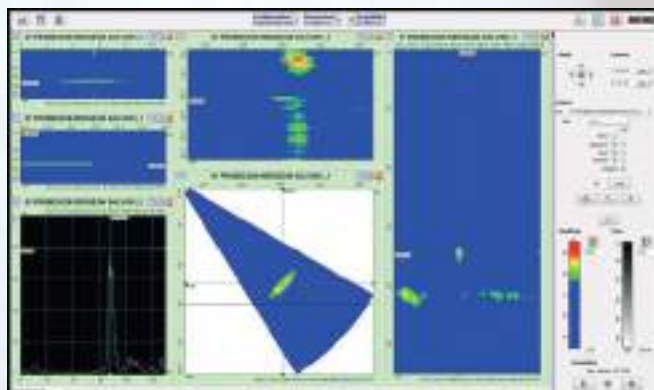
Tecnatom offers services and products on inspection and testing, plant operation and training, and process engineering, to the nuclear energy, transport and aerospace markets.

Capabilities and interests:

- Inspection, including Non Destructive Examination (NDE) equipment and services
- Remote Handling activities
- Instrumentation and Control
- Neutronics analysis
- Simulation, Control room design and manufacturing, Man-machine interface, Human factors

Awarded contracts and R&D projects:

Qualification of NDE activities during the manufacturing of ITER Vacuum Vessel (VV) Sectors
NDE activities during the manufacturing of pre-compression rings of ITER VV



Results of an ultrasonic technique for ITER Vacuum Vessel sectors welds inspection

TELSTAR TECHNOLOGIES SLU



Address: Avinguda Font i Sagué, 55
08227 Terrassa (Barcelona), SPAIN

Web: www.telstar-vacuum.com

Turnover: 46.77 M€ in year 2011

Contact person: Ferran Costas, *Space & Science Business Development*
+34 937 361 600
fcostas@telstar.eu

Fusion activities:

Telstar Vacuum Business Division, within Telstar Technologies, is devoted to providing solutions to its customers, based on vacuum, cryogenics, mechanical and control technologies . Telstar has engineering, manufacturing, integration, installation and test capabilities, to provide operational systems on a turnkey basis. Telstar has interests in fusion concerning remote handling, high vacuum and cryogenics.

Awarded contracts and R&D projects:

Divertor Remote Handling Prototyping

Telstar, under a EFDA contract , supplied prototypes for the Cassette Multifunctional Mover (CMM) and Second Cassette End Effector (SCEE). They have been successfully tested in DTP2 – Tampere - Finland.

Telstar supplied pump-sets and vacuum control and measurement equipment for CIEMAT TJ-II Stellarator fusion research machine.



Divertor RH prototyping: Test stand, CMM and SCEE



Divertor RH prototyping: CMM & SCEE lifting a dummy load

Address: PCTCAN. C/ Albert Einstein 14
39011 Santander, SPAIN

Web: www.ttinorte.es

Turnover: 8 M€ in year 2012

Contact person: Miguel Peña, *Commercial Manager*
+34 942 291 212
mpena@ttinorte.es

Fusion activities:

TTI works in the technological forefronts of **space, military, telecommunications, science, and information technology** sectors. TTI works in the radiofrequency and antenna technology fields developing advanced products (detailed design, prototyping, testing and validation) for its later mass production, as well as integrating complex communication systems, providing turnkey solutions.

For fusion activities, our main areas of expertise are:

- **Solid state power amplifiers** based on LDMOS solid state technology, up to tens of KW and covering a wide range of frequencies.
- **RF passive devices:**
 - Development of *waveguide components* for particle accelerators for multi megawatt applications in ultra-high vacuum conditions at different working frequencies (S, C, and X Band)
 - Coaxial high power coupler* for RF cavities
 - High power test-box RF cavities* for coupler RF conditioning (Capacitive and Inductive type)
 - Coaxial power combiner*

Given our capabilities, our main areas of interest within fusion and ITER activities are: Diagnostic systems, plasma heating and control.

Awarded contracts and R&D projects:

LINAC RESEARCH FACILITY HUELVA UNIVERSITY

Design and manufacturing standalone **1.2KW Solid State Power Amplifier @ 80Mhz**. Design and manufacturing of **high gradient superconducting half-wave resonator RF cavity**.

IFMIF/EVEDA:

Detailed design of **PROTECTION system**/devices HW/SW of RF module. Design and manufacturing of **Test Bench for High Power RF coupler conditioning**.

CERN:

Supply of the **X-band Bi-directional coupler with RF pickups**.

R&D projects:

ACELTEC (INTERCONNECTA-CDTI): Design and development of high gradient superconducting RF Cavities for particle accelerator applications.



X band bidirectional coupler



SSPA 10 kW



Centro para el Desarrollo
Tecnológico Industrial



Cimat

Centro de Programas
Analíticos, Modelización
y Simulación