

noticias



Concentrated solar power MISSION ACCOMPLISHED

*Construction works at the
Gemasolar thermosolar plant.*



MARINE

FORAN V70

*New generation
of CAD/CAM/CAE
systems*

TRIBUNE

Hashim Al Hashimi
*Land Transport Director
of the Abu Dhabi's
Department of Transport
(DoT)*

TECHNOLOGY

Optical systems
*High precision
focused on planetary
exploration*



“I see distances getting shorter”

The way to see the future can be through the opening of new routes. Routes such as innovation, developing international markets or integration with the environment are paths the SENER civil engineering and architecture unit is accustomed to travelling. Conventional and high speed railways, metros and light rail trains, roads and highways, airports, ports, maritime works, hydraulics, environment, architecture and urban planning. Are just a few areas where we create milestone works in our journey towards the society's well being.

The way to see the future. SENER Civil and Architecture

**SENER**

www.sener.es

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In the cover: construction works at the Gemasolar thermosolar plant, in September 2010.

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AT THE FOREFRONT OF INNOVATION

Concentrated solar power: mission accomplished for SENER

SENER Grupo de Ingeniería is now the leading company in the **development of innovative solutions** according to the number of **projects it has in progress**.

In this page: SENERtrough, the parabolic trough collector system developed by SENER, lighter and easier to install. *In the next page:* construction works at Gemasolar plant, the first in the world with tower technology and molten salts storage system.

The engineering projects in the field of Concentrated Solar Power (CSP), successfully carried out by SENER Ingeniería y Sistemas, add up to a total of 15, which will have a total installed power of 1 GWe once construction has finished. Among these are the three innovative plants of Torresol Energy, a company incorporated by SENER as a joint venture with Masdar, to promote large CSP plants around the world, allowing SENER to exploit its own technology.

Since the end of 2005, when it started its first large commercial project, Andasol-1, the major

innovations of SENER, which have helped its plants maximize their efficiency, have enabled the company to secure a considerable portfolio of contracts, and are now being adopted by leading competitors. For example, the molten salt storage system that SENER installs in all the plants it develops, with parabolic trough or tower technology, has revolutionized the CSP market, and leading competitors are beginning to look into adopting similar systems. The thermal storage system allows plants using SENER technology to continue producing electricity at night or during cloudy weather, turning a renewable source like solar energy into a dispatchable energy, capable of supplying electricity in line with demand, unlike other technologies such as wind power, which has no storage option.

SENER recently won the engineering and construction contract for the solar arrays of three new CSP plants. These are ASTE 1 A and ASTE 1 B, located in Ciudad Real, and Termosolar Soluz Guzmán, in Córdoba, all in Spain. The three plants, using parabolic trough collector technologies with a power of 50 MW each, could be operational by the end of 2012. These three new contracts bring SENER up to a total of 15 thermosolar plants throughout Spain, five of which are currently operational. These plans will have a total installed power of 1 GWe once construction has finished, making SENER the leader in terms of the number of projects. Two of them, Andasol-1 and Gemasolar, have been true milestones for the CSP industry.





In this page: optimized thermal storage system in the Power Block of La Florida plant, owned by SAMCA, with three salt-oil heat exchangers. *In the next page, above:* heliostats in Gemasolar plant, owned by Torresol Energy. *Below:* general view of the Valle 1 and Valle 2 plants, also owned by Torresol Energy and build, as EPC contract, by SENER.

A story of R&D

Few companies can boast such a long history of research and development in CSP technology. SENER, a high-tech company with innovation as its main distinguishing feature, which lists facing up to new challenges as one of its driving forces, was soon attracted to the opportunities for development to be found in a new form of power: concentrated solar power, capable of generating high-power electricity and thus of becoming an alternative to large conventional power plants. As early as the 1980s, the company had started to develop solar technology, including the first heliostats, but it did not get involved with the first CSP plant project, Solar Tres, until 2001. This was an experimental plant with a central tower and heliostat design, in collaboration with the companies Ghersa, Boeing and Nexant. SENER eventually became the project leader. Solar Tres allowed the company to conduct a thorough study of the real opportunities found in the solar power industry, and to make an investment in R&D that would lead to the first large-scale technological developments in CSP.

By 2005, SENER had sufficiently matured its research in thermosolar power to be able to undertake its first commercial project, the Andasol-I plant. Owned by ACS, developed in a joint venture with Cobra, SENER carried out the engineering, construction, commissioning and commercial operation monitoring of the plant. This plant used parabolic trough technology, which was already efficiently used in the USA and had gained popularity in the thermosolar market. SENER added a molten salt storage system to this plant, thus extending its operating period by up to 8 hours without solar radiation. Connected to the grid at the end of 2008, it set a global milestone as the first commercial plant with storage capacity. The fulfilling experience with Andasol-I gave SENER the opportunity to undertake other similar projects, winning 15 contracts in only six years.

Gemasolar is another global milestone, as the first commercial plant with central tower and heliostat array technology to include a thermal storage system. With a turbine of less than 20 MW, its production will be similar to that of a 50 MW parabolic trough plant without thermal storage. Overall, Gemasolar

will supply clean, safe energy to 25,000 homes and reduce CO₂ emissions by more than 30,000 tones a year. Studies conducted by SENER have confirmed that this technology will be the most cost-effective, since it has a simple design which is still capable of generating electricity with greater efficiency and higher thermal storage capacity than parabolic trough technology. SENER has invested heavily in this plant, in which it also has a 60% stake through Torresol Energy. However, it will definitely bring returns in the medium term: when its comes into operation in 2011, Gemasolar will be an international reference and a starting point in the cost-cutting strategy of the thermosolar power industry; commercial operation of this plant will prove the efficiency of tower technology with molten salts receiver, paving the way for other similar plants around the world, which will enable industrial production like we see today with parabolic trough technology.

The talent of an experienced team

This innovative effort is key in explaining the leading position of SENER, as summarized in its competitiveness. SENER has been developing pioneering plants since the 1980s, which has afforded it a remarkable technological advantage over its competitors. Furthermore, this ability to think ahead has enabled the company to train experts in the field of CSP: engineers from various disciplines, who have seen solar projects through from initial design to commissioning, also responsible for following up their operation, and who today continue to work



NEW RESPONSIBILITIES, NEW MARKETS.

The progress of the company has not gone unnoticed by its customers, who have gradually entrusted more tasks to the SENER engineering team over the last six years. Today, the company is involved in every phase of its projects, from initial design to commissioning and maintenance. It has also grown internationally, thanks to the good results its projects have

obtained in Spain. Thus, in the USA, where it has an office dealing mainly with the promotion of solar projects, the company is working on two CSP projects, and in Abu Dhabi it has started to design two central tower plants with storage system. In addition, it has begun to study a variety of CSP projects in countries such as India, South Africa, Australia and Mexico. Since the start, SENER's goal is to lead projects around

the world in the field of concentrated solar power: SENER Ingeniería y Sistemas is looking for opportunities beyond the domestic market; and Torresol Energy has this same objective as one of its founding goals, with the mission of promoting large solar plants around the world, especially in the so-called 'solar belt': Southern Europe, Northern Africa, the Middle East and the Southwestern USA.



at SENER. This highly qualified team is key for identifying improvements in CSP developments, which the company has gradually applied in each project, in a constant progression. Its developments therefore comprise computer programs for managing and operating solar plants, such as its SENSOL software, which has gradually incorporated new applications in subsequent versions; its collector design, the SENERtrough system, which enables notable savings in installation and maintenance costs; its salt storage system, which is constantly looking for ways to increase its efficiency –for instance, SENER is currently undertaking the construction of a prototype that removes one of the tanks from the circuit, resulting in a single-tank system, which would allow considerable cost savings-; and other improvements in power island installation, maintenance and operation... the engineers are constantly improving their skills. As for tower technology, with the first commercial project still in construction, SENER has already started planning a second generation, with a new layout of the solar field, capable of more efficient plant management.

With its sights set on the future, the company is still devoting a considerable number of working hours to research and development. In this way, SENER is making the most of its multi-discipline nature, as a company working in the sectors of Aerospace, Power and Process, Civil Engineering and Architecture and Marine Engineering, with access to experts in every discipline, applying innovations in all these fields to solar technology. On the other hand, the company Torresol Energy has plans to set up research centers at each one of its plants for testing prototypes at the actual plant. Furthermore, SENER engineers frequently collaborate with technology centers, such as the Plataforma Solar de Almería, belonging to the CIEMAT (Ministry of Industry), universities, technology centres such as the Technological Corporation of Andalusia, The Andalusian Technology Centre for Renewable Energies or institutions such as the Basque Energy Board (EVE), through innovative projects.

This innovative effort is key in explaining the **leading position of SENER**, that has already 15 CSP plants under development.



The main goal of all the research and development efforts by SENER Ingeniería y Sistemas as well as Torresol Energy is to achieve significant reductions in the cost of generating this type of electricity, in order to make it a true alternative to conventional power, both financially competitive and sustainable.

In this regard, the two companies share the same ideas as their parent group, SENER Grupo de Ingeniería: to offer the most advanced technological solutions in the fields where it is possible to develop innovations and where the talent of SENER, which is the sum of the talent of its professionals, can contribute to improving society as a whole. ■■

“SENER has technical self-confidence that differentiates us from our competitors”

Miguel Domingo

Solar Business Director of SENER

Question: How is SENER going to embark upon the concentrated solar power market?

Miguel Domingo: SENER has been active in the solar market since the 1980s but its first major commercial project was, without a doubt, the Andasol-1 project, which was launched towards the end of 2005. As a result, SENER has developed a very strong team specializing in solar thermal power. Andasol-1 was really the start of SENER's solar thermal activity. However, our main project is Gemasolar, which also poses a much greater risk for SENER. Unlike Andasol-1, which is a joint venture between Cobra (80%) and SENER (20%) in which we have no stockholding, we actually own 60% of Gemasolar and are responsible for the EPC.

Q: SENER develops both parabolic trough collector technology and central tower and heliostat technology. Do you prefer either of these technologies?

M.D.: They are complementary technologies. Central tower with molten salt receiver technology offers many advantages over parabolic trough technology but there are not yet any commercial plants in operation. When SENER's first commercial project, Andasol-1, based on parabolic trough technology was launched, there were already similar plants in America that had been operating for 20 years while there were still only tower technology prototypes, experimental plants such as Solar Two. Therefore, finding financing for tower plants was much more difficult than for parabolic trough plants. The fact that SENER is involved in so many parabolic trough plants is particularly a matter of opportunity as this type of technology, due to being older and more developed, was what the market demanded and could be financed much more easily by the banks. However, central tower technology is really much simpler: it involves less working fluids, solar field design is simpler and it can be better adapted to the lie of the land due to being made up of independent heliostats... It has simply not yet had the opportunity to be implemented extensively.

We believe, and we have checked it with detailed assessments, that molten-salt tower technology is often superior to parabolic trough

technology. What we must try to achieve is that tower technology receives the same standardization as parabolic trough technology has received. Therefore, the Gemasolar commercial operation in 2011 will be the start of a new learning curve because you can learn a lot with a project and industrialize many aspects and then everything learned can be applied to future tower technology plants. Also, part of the technology for the parabolic trough plants used to come from other companies (from Israel, Germany, etc.) but for the tower plant, we have managed to control all plant costs by developing our own technology. That is one major difference.

Q: The main technological difference of the solar plants developed by SENER revolves around the storage system. What is that so important?

M.D.: Plants with storage capacity can continue to operate even when there are clouds in the sky and can offer more working hours as they can continue to produce electricity even when there is no sun. And the important thing to take into account for a plant is its production, the amount of energy that can be sold at the end of the day and how your supply meets the demand curve. Thanks to its storage capacity, even if we have a power of less than 20 MW, as is the case with Gemasolar, we can produce as much energy as a 50 MW parabolic trough plant that has no storage capacity and also supply better controlled electricity to the grid.

I believe that in the future we are going to come face to face with competition for the technologies we have already developed and in time, it seems that these are the technologies being demanded by the market: parabolic trough collector technology with storage system, which already exists and where SENER has clearly differentiated itself from its competition on launching its first commercial project, Andasol-1, with the plan to implement this technology in many more projects; and central tower technology with storage, which is the technology to be launched shortly. The storage system gives the plant very important operating flexibility and that is exactly why the competition is adopting this technology. And that is why here at SENER we are already researching improvements to cut the cost of



“Today we have an extensive solar technology team with exceptional experience. Its members have come together as a result of participating in state-of-the-art projects, such as Andasol-1, and they have been involved in all stages of a project”

this system. We are coming up with new ideas with each project that will always be applicable to commercial projects.

Q: Would you say that SENER is today a world leader in solar technology?

M.D.: We are very well positioned due to all these technological advances. This position has a lot to do with what SENER's employees are like and what the company as a whole is like. For a start, we like technological challenges and know how to face them thanks to the fact that we have highly trained individuals with a global vision of the plant who can integrate all their knowledge and also specialists in each specific discipline who are capable of implementing technological innovations in each project. And we also have a shared culture thanks to our multi-disciplinary nature that sets SENER apart from other engineering companies. For example, knowledge gained from aerospace projects in terms of mechanisms and structures has helped us develop new products for the solar market. And these are innovative approaches that can be applied without fear thanks to the fact that SENER has technical self-confidence that definitely differentiates us from our competition.

Q: So does SENER have its own team of solar thermal power technologists?

M.D.: Yes, of course. The solar sector also attracts enormous talent as it has many qualities that motivate individuals who are passionate about engineering: it involves large projects dealing with different technologies, with a high level of innovation, that are followed from beginning to end, from design to commissioning... Today we have

an extensive solar technology team with exceptional experience. Its members have come together as a result of participating in state-of-the-art projects, such as Andasol-1, and they have been involved in all stages of a project, from its preliminary design to its commissioning and follow-up. Also, as SENER is proud to put its people first, these highly experienced professionals continue to work as part of the company with great enthusiasm. We can proudly state that we have a magnificent team of solar technology professionals. And in that regard, in terms of people, we are definitely world leaders. This gives our clients great peace of mind. Of course, you have to be competitive to win a contract but we combine good price with quality work teams that inspire maximum confidence and that is what has helped us take part in so many projects, five of which are already in operation, operating at full capacity. We monitor and follow up on progress at these plants and this follow-up stage forms part of our guarantee with the client and is also an exceptional opportunity to detect improvements that can be implemented in future projects.

Q: Besides the 15 projects in Spain, where else have you carried out projects?

M.D.: We offer engineering, construction, operation and maintenance services in the USA and already have two projects underway with an important team of people working there. Spanish companies have a great deal of prestige in renewable energies in the USA, as they do worldwide, and this is one of SENER's target markets; this country also has a social and political will to develop renewable energies. However, the USA is very large and complicated and we have to get the first projects we carry out right. We are also offering solar combined cycle hybridization in North America, in Mexico, which we are building in Agua Prieta. In Abu Dhabi our engineering department is helping Torresol Energy with its projects. Our technology is also being proposed for the Nehru Solar Mission plants in India and we are involved in emerging projects in Australia, South Africa and the MENA region. However, these are projects with a long development period. We must remember that initial projects in a country are always harder as we must adapt to the idiosyncrasies of that country, organize institutional aid, etc. But we expect to grow stronger in all those markets. ■■

Hashim Al Hashimi, Land Transport Director of Abu Dhabi

Connecting Abu Dhabi

The **Surface Transportation Master Plan (STMP)** was commissioned by the Government in order to deliver a world class transportation system to Abu Dhabi.

DOT
THE
DEPARTMENT
OF TRANSPORT
WORKS TO MAKE
THE VISION OF
HIS HIGHNESS
SHEIKH KHALIFA
BIN ZAYED
AL NAHYAN,
PRESIDENT OF
THE UNITED
ARAB EMIRATES
AND RULER OF
ABU DHABI, A
REALITY: ABU
DHABI REQUIRES
A HIGHLY
SOPHISTICATED
TRANSPORT
NETWORK THAT
WILL MOVE
PEOPLE AND
MATERIALS
EFFICIENTLY
THROUGH THE
EMIRATE, IN
A WAY THAT
CONTRIBUTES
TO THE QUALITY
OF LIFE FOR
ALL RESIDENTS,
BUSINESSES AND
VISITORS.



In February 2008, the Surface Transportation Master Plan (STMP) was commissioned by the Abu Dhabi Government in order to develop a plan that would deliver a world class transportation system that will support the vision of Plan Abu Dhabi 2030. The STMP addresses the regional transport needs of the Emirate of Abu Dhabi, while focusing particular attention on the requirements of metropolitan Abu Dhabi. Completed in early 2009, the STMP details six major passenger modes: metro, consisting of 130 km of two-way tracks, with stations every 3 to 5 km.; High-Speed Regional Rail, connecting Abu Dhabi, Dubai, and Al Ain; Light Rail Transit (LRT)/Tram, consisting of 340 km (estimated) of two-way tracks supporting high density areas; roadways, providing advanced technology and route guidance; bus, providing increased frequency and service of high quality buses; and Ferry and Water Taxi, supplementing the land-based transport network.

Feasibility studies for the Metro, LRT/Tram, and Regional Rail are already underway. In addition, work has just begun on the pedestrian master plan, the bikeway master plan, and the bus master plan. These plans will also form part of the blueprint for a better transportation system.

In early 2010, the DoT selected ADAPT, (a joint venture between Parsons Brinckerhoff International, AECOM, and DB International) to undertake the Abu Dhabi Metro Study. The objectives of the Metro study are to define and develop a project definition that will gain acceptance by the highest levels of Government.

The DoT, through this study will re-evaluate the recommendations and conclusions contained in the STMP in order to confirm if the Metro is needed as one of the solutions to address Abu Dhabi's transportation issues. The study is in the alternatives analysis phase which investigates a number of options – including buses, bus rapid transit, light rail transit, and Metro – that could address the transportation demand. The results of the alternatives analysis will determine if the proposed Metro is an effective solution and cost-efficient solution; and, if so, also determine the most efficient alignment and technology for the system.

Besides, in May 2010, the DoT selected the Joint Venture SENER-TYPSA to develop the Abu Dhabi LRT/Tram study. The objectives of this study are to design and develop a world class and sustainable transportation system, to support residents' increasing demand for mobility (including demands arising from developments in all Abu Dhabi Metropolitan areas), to improve residents' quality of life, and to maximize social benefits. Since the LRT/Tram system will be a street-running system, its urban integration will help to restructure the city and recover for more effective use by residents and visitors some main streets that are currently used predominantly by private vehicles.

Considerations to be included in the LRT/Tram network design include the latest, proven, cutting edge technologies, and the specific characteristics of the region; for example, high temperatures throughout the year (which can reach more than 45 °C during summer season), and the presence of sand and dust (due to proximity to the desert). To meet such requirements, all LRT/Tram equipment and facilities will be specified and prepared for high performance in extreme conditions. Furthermore, to provide passengers with high levels of comfort at all times during their travel, it is envisaged that both LRT/Tram vehicles and shelters at stations will be air-conditioned.

The study will also identify a Minimum Operating Segment (MOS) situated in the north of the city – an area with higher rates of population – that will be the first LRT/Tram line to be designed and constructed. The length of this MOS might be about 30 km. It is essential that the LRT/Tram network encompasses both Abu Dhabi metropolitan area and all new developments within Abu Dhabi downtown. Some of these new developments are priority areas, as are Al Sowwah Island (will be the new Abu Dhabi financial centre), Al Reem Island, Saadiyat Island (will be a cultural area of world renown), Capital District (where major Governmental Ministries and Agencies will be located), etc. To this end, the DoT is coordinating with stakeholders and developers in order to identify the most effective corridors and stations for the LRT/Tram network. ■■



Up to date:

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PROJECTS FOR THE A350 XWB

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MADRID-SARAGOSSA-BARCELONA-FRENCH BORDER HSL

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Power and Process ■

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POZA RICA THERMOELECTRIC STATION

NEW FACILITIES FOR BP OIL IN THE PORT OF CASTELLON

AGUA PRIETA II COMBINED CYCLE POWER PLANT

AGUADA TOLEDO AND SIERRA BARROSA OIL FIELDS

TERMOZULIA II COMBINED CYCLE POWER PLANT

ESCOBAR REGASIFICATION TERMINAL

Marine ■

FORAN V70

PORT SERVICES WORKBOAT FOR CONSULMAR

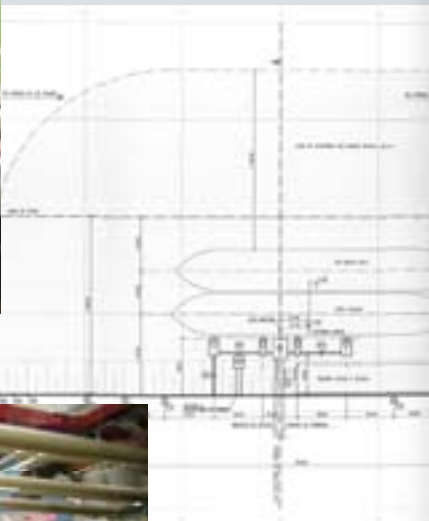
FORAN FOR HARVIN ENGINEERING UNIVERSITY

ACERGY HAVILA VESSEL

ENGINEERING FOR UNV

Group ■

ENERGY AND ENVIRONMENT



MELISSA PROJECT

Life-support system for long-duration space travel

NTE-SENER is participating in the MELISSA project (Micro-Ecological Life Support System), which has the long-term goal of developing a life-support system for long-duration space travel and planetary bases. The system consists on recovering air, water and food from waste generated by the crew by means of biological processes carried out by bacteria, algae and higher plants.

With its sights set on 2025-2030, MELISSA is coordinated by the European Space Agency (ESA) and includes the participation of several universities, technology centres and companies from Europe and Canada.

A pilot plant is currently installed at the Autonomous University of Barcelona. The plant is made up of four bioreactors, a compartment with higher plants and a consumer compartment. The first three bioreactors are responsible for recycling, while the fourth bioreactor and the plant compartment are responsible for producing water, air and food. The consumer compartment is populated with enough lab mice to simulate the oxygen consumption of one human. The project has already spun off various technologies with common applications relating to filtering and recycling wastewater.

NTE-SENER has been participating in the MELISSA project since 1996. The company was involved in selecting the site



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for the pilot plant and provided technical and engineering assistance for the development of the plant. It has also conducted studies aimed at a possible implementation of the system using space technology. The adaptation of this project to space technology is a major challenge, considering the size of the system, the variety of the technologies and disciplines involved and the inherent complexity of the control system. ■■

In the images: two different views of the pilot plant installed in the Autonomous University of Barcelona.



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SPACE TELESCOPE

Planck sends its first image of the Universe

The Planck space telescope, a project in which SENER has taken major participation, has sent its first full image of the Universe to Earth. From the closest regions of the Milky Way, to the limits of space and time, the first full-sky image taken by Planck is an extraordinary treasure, full of fresh data for astronomers. "With these results we are not providing an answer, but are opening the door for scientists to be able to look for the missing links that will enable us to understand how the Universe was formed and how it has evolved since then", stated the Director of Science and Robotic Exploration of the European Space Agency (ESA), David Southwood. Moreover, the Director of SENER's Space Department, Diego Rodríguez, said that "both SENER and the team that has worked on this

project for over seven years are proud of the excellent results achieved in one of the most complex Guidance and Control systems that has ever flown on a European Space Agency mission, and the first system of this type performed by a Spanish company for ESA".

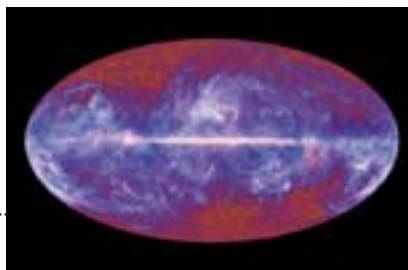
Planck, launched along with the Herschel telescope last year, will study the origin of the Universe on the basis of the residual radiation from the first radiation that was

present in the Universe shortly after the Big Bang and which remains travelling in the space, known as the Cosmic Microwave Background (CMB). With the help of Planck, astronomers expect to investigate and ratify the theories on the birth and evolution of the Universe, going back some fourteen billion years to the beginning of time and space as we know it. ■■

In the image below: first image of the Universe sent by Planck.

COMPLETE ATTITUDE AND ORBIT CONTROL SYSTEM. Within the industrial consortium developing this mission, SENER leads the complete Attitude and Orbit Control System (AOCS/GNC) of the Planck satellite and plays an important role in the AOCS/GNC of Herschel, where the company also shares the responsibility of the system. This system is responsible of locating the

spacecraft at the required positions (orbit control), maintaining them with the adequate pointing and stabilization profiles (attitude control) and executing the desired orbital and attitude maneuvers, as well as correcting any possible deviations. Satellite and telescope pointing, and its scanning, are measured, determined and controlled by the system of which SENER is responsible of, and includes sensing equipments, computer, decision logics, software, and actuation equipments needed for its control. "This is also one of the most critical systems for the spacecraft and forms part of the ESA's most important scientific mission to date", asserts Diego Rodríguez.



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AIRBUS A350 XWB

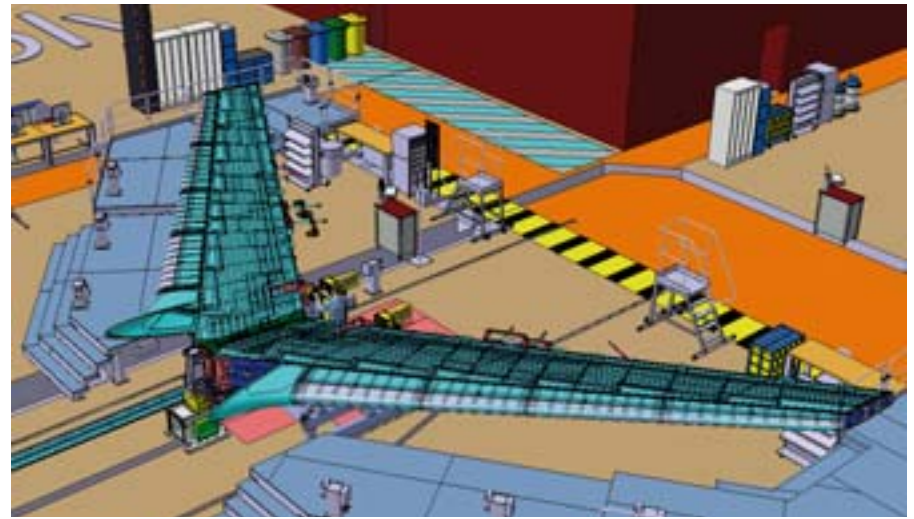
Design and production of HTP assembly stations 70 and 71

In March 2010, the German company Thyssenkrupp Systems Engineering awarded SENER the project for development, turnkey supply and commissioning of part of the assembly line for the horizontal tailplane of the Airbus A350 XWB aircraft, specifically stations 70 and 71.

The final assembly of the horizontal tailplane (HTP) of the Airbus A350 XWB aircraft is carried out at the Airbus plant in Getafe (Madrid). The assembly operations include

AN OUTSTANDING CONTRACT.

Ergonomic and safety-related aspects are of particular importance in this project, as is the accurate positioning to be ensured by the facility, since this is a large-scale structure on which a variety of manual operations are performed. Also, this is an important



marrying up the HTP and fitting it out (installing fittings, electrical and hydraulic systems).

Thyssenkrupp Systems Engineering is responsible for the complete assembly line, which comprises various stations: 59, 60 and 61 for assembly (awarded to the company MTorres) and 70, 71, 72, 80, 81, 82 and 89 for fitting and final inspection. In parallel, the German company awarded SENER the de-

sign and turnkey production of a part of said facility, specifically stations 70 and 71, as well as drilling templates. Integration will be done at SENER's Integration and Test Centre at San Agustín de Guadalix (Madrid). Various front and rear fittings of the aircraft are assembled at these stations and subsequently used for connecting the HTP to the empennage or tail unit of the A350. SENER is also in charge of the templates for HTP drilling operations, for assembling the wing tip and rear fittings. Having completed the engineering phase, SENER is currently working on the production phase. Airbus is expected to accept the project in February next year, with completion scheduled for July 2011. ■■

In the image: artistic view of part of the HTP assembly station designed by SENER.

ANOTHER PROJECT FOR THE A350 XWB

Wing stringer production and positioning cell

SENER is participating in the AIRBUS wing stringer production cell project, contracted out to ARITEX, with the goal of automating the production of wing stringers for the top and bottom skins of the wings of the A350 XWB (Extra Wide Body) aircraft. Specifically, SENER is responsible for one of three work systems, 'Work System A' (WSA), which consists of generating the carbon fibre laminates, cutting them to the dimensions required for each stringer and storing them for subsequent use and shaping.

The scope of the project includes designing, building, assembling,

testing and commissioning the WSA in cells respectively installed in Illescas (Toledo, Spain), where the bottom skin is produced, and in Stade (Germany), where the top skin is produced.

The production line should have an initial production rate of three aircraft a month, eventually reaching a rate of seven to 13 aircraft a month. AIRBUS is planning to build the A350 XWB aircraft in versions 800, 900 and 1000, which means that the required line must support flexible production of all three versions.

This work system was recently modified at the customer's request, since Airbus has decided to use new fibre laying units (FLU), designed by the company MTorres. These machines, included in the new WSA FLU system, can be used for laminating parts for stringers individually, making much better use of the material.

Having made the necessary modifications to the new WSA FLU system, SENER is in the commissioning phase of the Stade and Illescas installations for the R3 production



rate, as well as in the manufacturing phase of the R7. The complete project is scheduled for completion in July 2012. ■■

In the image: assembly line in the Stade plant, in Germany.



A WELL-EQUIPPED PLANT. The pilot plant consist of the following subsystems: sea water pumping and filtering; sea water flow and pressure control; gases storage, treatment and dosage; reactor-dissolver; PH-meters, sample takers and other systems to assess the achieved degree of dissolution. Taking into account the data obtained by this systems to date, the tests performed have shown satisfactory results but still some parameters are under study in order to obtain optimum operation configuration.

CO₂ DISSOLVER INTO SEA WATER

Functional test of a **pilot plant**

SENER is performing the functional tests of a pilot plant based on an own design to assess the dissolution of CO₂ y O₂ into sea water. These tests are taking place in a Spanish harbour and are framed under a collaboration agreement signed with HDW, one of the main non nuclear submarines manufacturer in the world.

The design of the plant was born as part of an internal research to develop a system to dissolve into sea water the exhausted gases of a methanol reformer, chemical plant used by some anaerobic submarines to produce the needed energy for the propulsion of the submarine. These submarines belong to the AIP submarines (Air Independent Propulsion) and their main advantage is that they avoid the need to surface or use a snorkel to access atmospheric oxygen required for the diesel-electric propulsion.

Main objective of the methanol reformer is H₂ production, afterwards used in a fuel cell to generate electricity. A methanol reformer has other sub-products that cannot be used for electricity generation and that have to be got rid of.

The above mentioned gases are mainly CO₂ and a small amount of O₂.

The problem to solve is the dissolution of those gases into sea water in a way that neither noise nor bubbles are produced to minimise submarine detection.

Different configurations are being assessed in the pilot plan to reproduce real conditions of several seas and oceans in order to get the optimum operation parameters.

Target results are contents of dissolved gases, achieved dissolution after the process, bubbles size of not dissolved gases and noise produced by the plant. ■■

Above, in both images: the pilot plant designed by SENER. **Below:** preparing a test in the pilot plant.





HIGH-CONCENTRATION PHOTOVOLTAICS

Design and supply of solar trackers for certifying high-concentration modules

SENER, through its Aerospace Strategic Business Unit (UENA), as part of its high-precision solar tracker portfolio, has developed a new product for high-concentration photovoltaics.

The new tracker can be used to run tests for design qualification and approval of concentrator photovoltaic

(CPV) modules in accordance with the demanding specifications of international standard IEC 62108:07 'Concentrator photovoltaic (CPV) modules and assemblies-Design qualification and type approval'.

The tracker has specific properties that make it suitable for this application.

Among these are its high precision and reliability, which ensure that the properties of the tracker do not interfere with the modules' characterization. Likewise, the tracker has an innovative structural design which supports simultaneous installation and measurement of modules from different CPV manufacturers. This is quite relevant, since CPV module design is not standardised, meaning that each module has different weight and size specifications and the tracker must be capable of integrating the various models simultaneously.

CENER (National Renewable Energy Centre) is the first lab in Spain and the second in the world to receive credentials for certifying high-concentration modules according to the aforementioned standard, for which purpose it selected the SENER tracker. Other centres, such as the ISFOC (Concentration Photovoltaics Institute) and the INTA (National Institute for Aerospace Technology) are in the process of achieving these credentials and have also selected the SENER tracker for this purpose.

This tracker joins the catalogue of products SENER offers for high-precision solar tracking, ranging from thermosolar (heliostats, Stirling discs) to photovoltaics (CPV and PV). In both fields, SENER can offer sizes ranging from 20 sqm to 120 sqm, supplying individual mechanisms as well as complete trackers. ■

In the image above: SENER tracker installed in the ISFOC.

LASESA PHOTOVOLTAIC PLANT

SENER completes the supply of 720 two axes drives for solar tracking

Last May the LASESA 9 MW photovoltaic plant, which is being installed in Sariñena, Huesca (Spain) started operation. It is one of the largest photovoltaic plants in Spain and has 720 two axes solar trackers designed by SENER. The design of this tracker is based in the two-axes drive for solar tracking (MASS) designed and patented by the same company.

The solar tracker installed is of the single-post type, of 112 sqm, with capacity for 80 standard panels and a production of



14 kW. It is characterised by its high load capacity, reliability and mechanical and structural stiffness.

The configuration of the solar tracker is the result of maximising the net surface and, at the same time, its high

reliability and cost optimisation guarantees production throughout the plant's 25 years of life cycle, thus leveraging the investment in two-axes tracking. ■

In the image above: solar trackers in the LASESA photovoltaic plant.

ABU DHABI: A CITY FOR THE FUTURE

Abu Dhabi light rail transit system study

Abu Dhabi continues to grow aligned with the 'ABU DHABI 2030' plan, seeking to turn this city of United Arab Emirates into a world leader in development and sustainability.

This ambitious Plan includes infrastructures capable of providing its inhabitants with an effective, safe and environmentally friendly public transportation system. The Light Rail Transit System Study being drawn up by SENER, together with another Spanish engineering company, TYPSA, for the Abu Dhabi Emirate Department of Transport (DoT) is part of these efforts.

The study will be the basis for a first class



transportation system for the city with state-of-the-art technology, which may become an example for other capital cities in the GCC (Cooperation Council for the Arab States of the Gulf) region.

SENER has set up a number of objectives for this project: firstly, the development of the guidelines of Plan Abu Dhabi 2030 and the STMP (Surface Transport Master Plan); and, secondly, the implementation of a modern, world class, effective and sustainable system that will help also to embrace Arabic culture and

heritage. The definitive goal of the project will be to contribute to the improvement of all aspects of Abu Dhabi, without being limited to mobility.

SENER, which opened an office in Abu Dhabi in 2008, on account of the considerable potential offered by the United Arab Emirates in fields like Infrastructures and Energy, as well as Marine Architecture and Aerospace Industry, is currently involved in a number of processes for different urban transport projects, railways and airports, with the aim of having an increasingly stable presence both in the country and throughout the Gulf region.

This particular project has marked a very important milestone for SENER, and in particular for the Infrastructure and Architecture Business Unit, in order to consolidate the activity in this geographical area which will represent a priority market for the company over the next coming years, and in which SENER has made, from the creation of Torresol Energy, together with Masdar, a sound commitment for a long term future. ■■

In the image: general view of Abu Dhabi.

FIVE PHASES IN THE PROJECT.

SENER is currently working on the initial phase of the LRT/Tram project. This first phase involves the study of alternatives for the city's light rail network as well as the conceptual design of the preferred option. These tasks are to be carried out over a period of 12 months. The next phase will consist on the Preliminary Design for the first part of the network located in the most central area

of the island and giving service to some of the most important urban developments currently under way (Saadiyat Island, known as the 'Island of the Museums', and Al Sowwah, the city's new financial centre). Phase 3 entails the development of the tender framework, which will be launched to carry out the implementation of the system, and phases 4 and 5 will cover the supervision of works and its implementation.

CONTRACTS IN MEXICO

Intelligent transport systems for managing the road network

Mexico, a country with over 100 million inhabitants, has a national road network of 357,000 km, 120,000 km of which belong to the main road network, divided between the state and federal networks.

Mexico has a total vehicle fleet of almost 30 million cars, and the major cities have densely populated urban areas: Mexico City has 16 million inhabitants, Guadalajara has 4.1 million, Monterrey has 3.7 million, and another 14 or 16 medium-sized cities have populations of between 1 and 2 million inhabitants.

The road network is near the point of saturation at nearly all these points. For

this reason, the Directorate-General of Road Development of the Department of Communication and Transport (SCT) has promoted the use of Intelligent Transport Systems (ITS) on highways in order to manage demand and control the state of the road network.

SENER, through its Mexico Division, has won two of the four international invitations to tender issued by the SCT, specifically the plan for modernising electronic payment systems on toll motorways, called 'Telepeaje', and the project for normalisation of ITS devices and protocols. By winning two of the four invitations to tender issued,

SENER has positioned itself as a leader in traffic systems engineering in Mexico.

In addition to these two contracts, SENER also won contracts for other transport engineering projects in Mexico in 2010. On the one hand, Autovía Necaxa-Tehuacán (AUNETD), the company licensed to build the motorway from Nuevo Necaxa to Tehuacán, has entrusted SENER with the task of drawing up the basic projects for the ITS and toll systems, as well as the construction project for toll buildings and on-site assistance for aspects including ITS facilities, tunnel safety, toll systems and the control centre for this road. The project consists of an 88-km motorway divided into two sections with six tunnels, ITS systems and tolls.

Finally, SENER won a new contract from the SCT to draw up the project for ITS systems on the Salamanca-León motorway, which strengthens its position as leading company in Mexico in the field of ITS engineering. ■■



BARCELONA METRO

Initial conclusions on **Line 9** integration

The first section of line 9 of Barcelona Metro, with 11 stations, recently entered commercial service. The line 9 project represents the largest investment in the history of the Catalan Regional Government, with an approximate budget of 6.8 billion euros, in which SENER has had a relevant participation.

The technical complexity and coordination required for this project led GISA to contract a Technical Integration Assistance (ATI) to a consortium led by SENER, providing overall management for the project and ensuring that all

subsystems are correctly commissioned until each section enters commercial operation. This work includes transversal coordination among all contractors and management companies, facilitating the interaction among subsystems to achieve maximum availability and stability of the whole system in commercial operation.

Key actions performed under the umbrella of integration include functional requirements, interface follow up, documentary management, the safety dossier and test coordination.

Although the integration activities are continuing its progress, the start of services on the first section of line 9 has allowed SENER to draw up an initial assessment of the work performed during technical integration. This work has made it possible to maintain global consistency with the general concept of the project throughout its execution, as well as providing a single set of documents with which to draw up consistent periodic reports. Likewise, the integration task

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allows gradual inclusion of new contractors throughout the duration of the works.

In this regard, integration is becoming an essential requirement in major urban transport projects around the world, given the lack of efficiency in attempting to operate a system made up of subsystems that are not adequately related to each other. The initial conclusions of SENER show that the integration tasks on line 9 have been successful so far. ■■

In the image: line 9 of Barcelona Metro.



MADRID-SARAGOSSA-BARCELONA-FRENCH BORDER HSL

Technical office assistance services for project management at **Sagrera**

ADIF has awarded SENER, in a temporary consortium with the companies GPO and INOCSA, the contract for technical office assistance services to the site management of two construction projects at Sagrera station. This station is on the Madrid-Saragossa-Barcelona-French border high-speed rail line.

The new high-speed rail line that will connect Madrid with the French border requires stations and infrastructure for access, maintenance and operation of the

line as it crosses Barcelona. Notable among these is Sagrera station, which is to become Barcelona's central station, replacing the existing Sants station. With forecasts in excess of 100 million passengers per year, Sagrera transport hub is one of the largest projects in Barcelona metropolitan area in recent years.

The station will connect the following transport systems: high-speed, long-distance and regional trains; commuter trains;

regular and private-hire bus lines; and Barcelona Metro lines 4 and 9.

The work contracted out to SENER as part of the temporary consortium, includes assistance in two separate projects: the station structure project and the railway access project. In the contract, the temporary consortium will have to carry out the adaptation of the structure of Sagrera station, the approaches to the station, the station facilities and conventional-line tunnels, the station architecture and urban development, as well as restoring the park and Ronda de Sant Martí, in order to ensure they are compatible with one another. The deadline for completion of this work is set at 56 months. ■■

In the images: three views of the current state of the lines, with provisional detours.



RAILWAY STATIONS

New Atocha station complex and related actions at Chamartín station

SENER has secured the contract for work to support the Railway Infrastructure Administrator (ADIF) during the projects defined in the Informative Study regarding the new railway complex at Atocha station as well as the required actions at Chamartín station.

By virtue of this contract, awarded in June 2010, the engineering company has supplied ADIF with a team of its own technicians capable of coordinating and supervising the five basic projects and

five construction projects defined in said study. Likewise, the company has offered a team of specialist thematic consultants, who will be capable of providing qualified advice during the stages of drawing up and checking the projects.

The team of general consultants will be made up of experts in the fields of Cartography and Topography; Geology and Geotechnics; Railway architecture; Environment; Tunnels and Underground Works; Layout; Hydrology and Drainage; Concrete and Metallic Structures; Expropriation; Restoration of affected roads, services and rights of way; Urban planning; and Technical specifications and Budgets. The team of thematic consultants includes specialists in Geotechnics and Earthworks, Tunnels and Underground Works, Hydrology and Drainage, Structures, and Conditioning Systems and Facilities. In addition to the above, the team will include several thematic consultants with expertise in Railway Functionality and Operation, Urban planning, and Railway facilities.



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According to the contract, SENER will also conduct work relating to specific aspects of information management. Finally, the need has been foreseen to conduct specific studies, analyses or surveys aimed at coordinating the works to maintain railway operations at Atocha and Chamartín stations.

The expected duration of this contract is 36 months from the awarding date. ■■

In the image: Atocha station.

HUELVA-FARO HIGH-SPEED RAILWAY

Market study and feasibility of the rail link

SENER, in a temporary consortium with the Portuguese company Consultores em Transportes, Inovação e Sistemas, S.A. (TIS), will conduct the 'Market study and analysis of technical, environmental, socioeconomic and financial feasibility of the Huelva-Faro high-speed rail link' for the High-Speed Spain Portugal European

Economic Interest Grouping (AVEP EEIG). The study has a double aim: on the one hand, to draw up a detailed analysis of passenger and goods traffic, using a four-stage model to provide the most accurate possible representation of the current mobility situation. In this way, the future demand of the link can be estimated and this

information can later be used as the basis for calculating the profitability of the investment by means of an economic and financial analysis. On the other hand, a study needs to be conducted (called a prior study in Spain and a technical feasibility study in Portugal) to define alternative routes and, ultimately, the selected route for the high-speed railway line that will link the domestic networks of the two countries.

The work method will be implemented over two stages: the first phase consists of defining and comparing the two alternative route layouts at a scale of 1:50,000, taking into account functional aspects, investment and operating costs, territorial and environmental impacts, determining urban factors, journey times and a preliminary analysis of demand gains and estimated income for the Huelva-Faro rail link; and the second phase of the study will enable final selection and development of the route, at a scale of 1:25,000, that is most suitable for the high-speed link between the two countries from functional, economic, environmental and territorial points of view. The studies of demand and socioeconomic and financial yield will be conducted in parallel to the two phases.

The deadline for this work is set at 24 months. ■■

In the image: Faro station.



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INFRASTRUCTURES IN COLOMBIA

Coffee Airport

Since April this year, SENER has been working on designing the buildings, infrastructures and equipments of the new Coffee Airport, located in the municipality of Palestina, in Colombia.

The contract, signed by SENER and the Coffee Airport Association in April, is part of the development aid the Spanish Government is supplying to Colombia. The design work being carried out by SENER is financed by a Fund for Feasibility Studies loan, while its subsequent execution will be financed by a Development Aid Fund loan.

Coffee Airport is located on the top of a hill in the heart of Colombia's coffee region, at an altitude of 1,550 m, in the municipality of Palestina, department of Caldas. The closest cities to the airport are Manizales, with a population of 370,000, and Pereira, with a population of 457,000.

The new airport aims to become a referent for the coffee producing area.

When it comes into operation, it will replace La Nubia Airport, located near Manizales.

Construction work on Coffee Airport is still in the earthwork phase, which entails considerable difficulty, since it involves a volume of approximately five million cubic meters, with earth containment heights of upto 45 m for sidehill cuts and 75 m for banks.

Once construction is complete, Coffee Airport will have one runway 2,100 m long, aprons for commercial and general aviation aircraft, and respective terminal areas. It will allow the operation of Airbus A319 and similar aircraft. In the future, the runway may be extended to a length of 3,300 m.

THE WORK OF SENER. On this airport, the works under contract include the following main activities: designing the paving, lighting and signing of the runway; designing the landside roads and infrastructures; designing the terminal building, with capacity for up to 500,000 passengers per year; designing the control tower; designing the fire and

As of today's date, SENER has completed and delivered the design of the airport's configuration (Master Plan), a key element for defining its layout. It has also conducted studies of demand and key routes for the planned operation of the airport, as well as preliminary designs of the three buildings. ■

In the images, above: future terminal area of the Coffee Airport, in an outside and interior view. *Below:* detail of the terminal roof design.



rescue services building; designing the air navigation equipment; and designing the passenger terminal equipment.

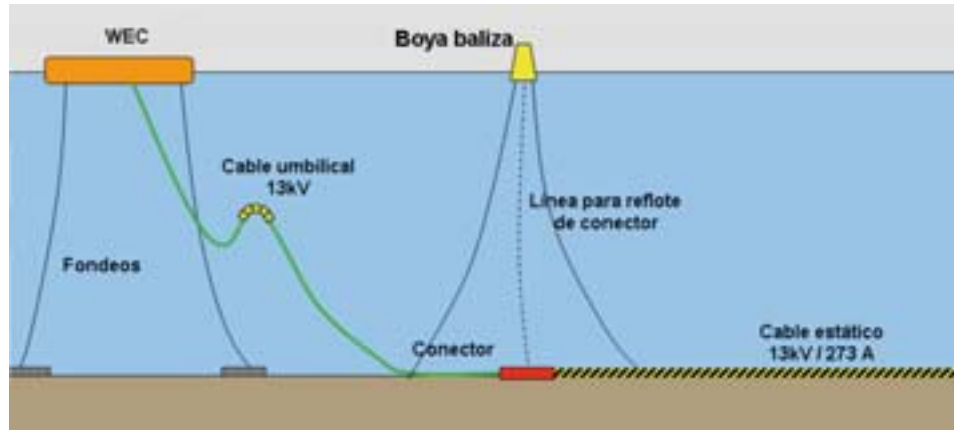
The deadline for completion of this work is set at ten months.

BIMEP PROJECT

Platform for testing and demonstrating wave energy converters

In its desire to promote the Basque industrial fabric in the new field of marine energy, the Basque Energy Agency (EVE) began in 2007 to develop a conceptual design of an infrastructure for testing and demonstrating open-sea wave energy converters called BIMEP (Biscay Marine Energy Platform). By building this infrastructure, EVE hopes to create a local industrial network around the new field of renewable energy which is marine energy, and specifically wave energy (that generated by wave movement), as well as to attract technology and investment companies in order to encourage possible relationships with local companies and turn the Basque Country into an international leading player in the sector.

The facility will be located opposite the coast of Armintza-Lemoiz, around 15 km from Bilbao, and will have an installed capacity of 20 MW, distributed across four moorings or offshore connection points, with 5 MW each. It will also include an electric substation on land,



to which each mooring/converter will be connected by means of a three-phase underwater cable in series with a three-phase land cable, both with 13.2 KV. Once on land, the existing electric infrastructure, built to evacuate power that would have been produced at the Lemoiz Nuclear Power Plant, will be used. The project will be completed with the installation of signalling and safety beacons for the platform as well as for the ships passing near the facility.

The project is split into four work packages: power lines, connection systems, substation and beaconing. The services contracted out to SENER include the following tasks: drawing up or supervising technical and administrative specifications for the four public invitations to tender; assessing tenders and proposals in order to select the winner of the four public invitations to

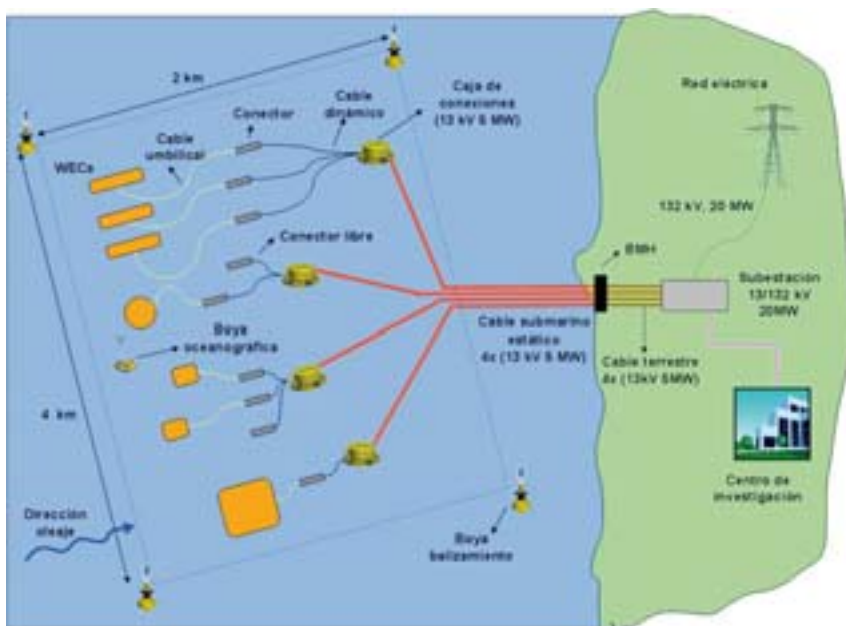
INVITATION TO TENDER. With its clear vocation for innovation and the desire to position itself in this new business, at the end of the summer of 2009, SENER, together with the Galician company ACSM, responded to the invitation to tender issued by EVE for awarding the contract for Site Engineering services for the BIMEP infrastructure in an open tendering procedure. A few weeks later, the company was awarded this contract, ahead of other major Basque engineering firms.

tender; supervising the supplies to certify that they comply with the specifications of each element of the infrastructure; supervising the progress of the works on each one of the four main contracts; managing the project and coordinating the companies awarded contracts as regards building and installing the various infrastructure elements.

Towards the end of 2009, SENER began to work on the electrical installation and connection system packages. It is currently working on the technical specifications for the electric substations and has started to develop the beaconing project for the infrastructure. All the works are scheduled for completion in summer 2011.

BIMEP is set to become the most important facility for testing and demonstrating wave energy converters in the world, together with the EMEC (European Marine Energy Centre) in Scotland. As in all its projects, SENER will contribute the quality and excellence that have been its hallmark throughout the fifty-plus years of company operations. ■

In both images, scheme of the operation of the BIMEP project.





BASIC AND DETAIL ENGINEERING

Modernising the Poza Rica thermoelectric power station

In May this year, SENER won the engineering development contract for repowering the Poza Rica thermoelectric power station, located at kilometer 194 of the Mexico City-Tuxpan Federal Highway in the municipality of

Tihuatlán, in Poza Rica (Veracruz State, Mexico).

The contract includes basic and detail engineering for the following tasks: dismantling, moving, installing and testing a Siemens W501F gas-turbine generator

unit, together with its auxiliary systems and equipment, including the gas measurement, regulation and control station; supplying, transport, installation and testing of a heat-recovery steam generator together with its auxiliary equipment; replacing, adapting, modifying or modernising the existing steam-turbine generators, capacitors, distributed control system and electrical substation; and, finally, interconnecting, integrating, testing and commissioning all the devices and systems so that, together, they form a 225 MW combined cycle.

SENER is carrying out the engineering works for all these tasks, which are scheduled to be completed on July 2011. ■■

In the image, above: machinery room of the Poza Rica power station. *Below:* outside view of the station equipments.



PORT OF CASTELLON

New facilities for BP Oil

BP Oil Refinería de Castellón, S.A. has awarded SENER the execution of the project for its new facilities in the port of Castellon, including the building of moorings for ships and the installations required for the loading and unloading of products for its refinery near the port, as well as the in-refinery facilities, the necessary equipment and the interconnection between the port and the refinery.

The project is split into two phases, and the work awarded to SENER initially corresponds to the first phase, consisting of the development of the engineering work needed to evaluate the cost of the investment.

Following completion of the work, scheduled for the last quarter of 2012, BP OIL will have gained a substantial improvement in ship loading and

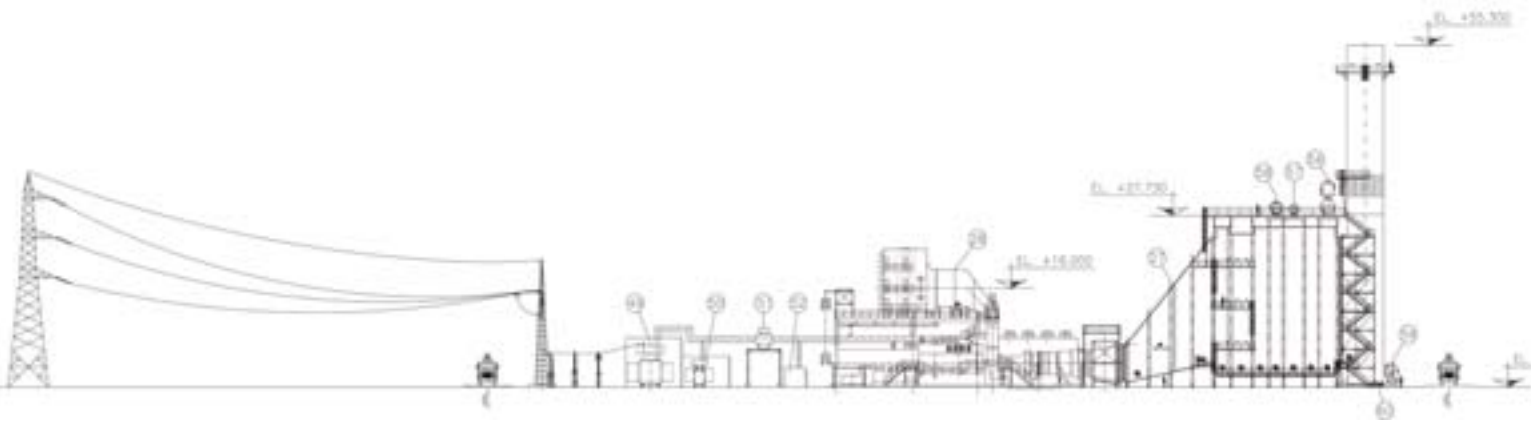
unloading operations at its refinery, as the new facilities will render it possible to perform these operations safely in the port on days when sea conditions are adverse, thus avoiding waiting times.

SENER's longstanding experience in refinery facilities and marine work were decisive in securing BP Oil's confidence for this project. Moreover, it is the second project carried out by the company for this client at its refinery in Castellon, following

the New Combined Power Plant. In the latter, SENER took care of the engineering services, procurement and the supervision of construction work, and also provided support in the commissioning of the plant, which has been operational since May 2009, with an installed capacity of 25 MWe and a steam output of 50 tonnes/hour. ■■

In the image: general view of the BP Oil facilities in the port of Castellon.





CONTRACT IN MEXICO

Agua Prieta II combined cycle power plant in Sonora

SENER, in a consortium with the ELECNOR company, has been awarded the contract for the design, construction and commissioning of the Agua Prieta II combined cycle power plant in Sonora, Mexico, for Comisión Federal de la Electricidad (CFE).

The power plant will have an installed capacity to generate 400 MW and will have two gas turbines and one steam turbine

supplied by CFE, two heat recovery steam generators with post-combustion, one air-cooled condenser and an aqueduct for the water supply.

The consortium will also interconnect an adjacent solar field, of 12 MW to the combined cycle to form a hybrid combined cycle. This solution leverages the energy delivered by the solar field to generate part of the steam that finally will enter the

steam turbine, thus providing fuel savings and the consequent economic benefit.

SENER has a 50% share in the consortium and will be the project leader, and it will also develop the complete engineering work for the plant.

The project will be managed in a joint venture structure, and both SENER and ELECNOR will provide their own manpower to set up the team that will implement the project.

The work execution period is 31 months, and the provisional handover of the power station is scheduled for April 2013. ■

In the image above: elevation view of the Agua Prieta II power plant.

BASIC ENGINEERING

Surface facilities for the Aguada Toledo and Sierra Barrosa oil fields

In May this year, YPF awarded SENER the contract for provision of process engineering and specialised services for the Aguada Toledo and Sierra Barrosa oil fields. These oil fields are located in Neuquén Province, in Argentina, around 1,200 km southwest of Buenos Aires city.

Within the scope of this contract, SENER will carry out the engineering work corresponding to the surface facilities associated with the two oil fields, as well as the pipes' engineering for interconnecting the two, flushing trunk lines and satellites, electrical installations and control and safety systems.

By awarding this contract, YPF is implicitly recognising SENER's

capabilities for the execution of basic and process engineering in upstream projects, i.e., for developing the engineering work required for exploration, production and delivery of a crude-oil export terminal. On the other

hand, this contract strengthens SENER's presence in this market segment, currently in great demand among oil companies. ■

In the image: aerial view of the works in the surface facilities.





CYCLE CLOSURE ENGINEERING

Termozulia II combined cycle power plant

SENER has been awarded the Project Management and the closure engineering work for the Termozulia II combined cycle power plant by ENELVEN (C. A. Energía Eléctrica de Venezuela), as well as the site engineering for the purchase, construction and commissioning of the cycle closure. The project is a thermal combined cycle power station of 500 MW, located in Maracaibo (Venezuela).

The jobs entailed in the current contract will be carried out jointly with Inelectra Venezuela and include the revision of detail engineering which has already been developed by the previous contractor, for the open cycle, and the carrying out of basic and detail engineering for the cycle closure with the corresponding purchasing specifications. Si-



milarly, SENER is responsible for Project Management, Engineering Management, the Site Technical Office and the commissioning and launch of the project.

The favorable opinion ENELVEN has formed of SENER was a considerable

factor in the award, thanks to the contributions made by the company during the start of its engineering work at the Termozulia III plant. ■■

In the image: aerial view of Termozulia II power plant.

LNG PROJECT IN ARGENTINA

Escobar regasification terminal in Buenos Aires

Argentina is looking for alternative power-generation sources for the country. In this context, it has recently experienced notable growth of the demand for natural gas. For this reason, ENARSA (Energía Argentina S.A.) and YPF S.A. have jointly undertaken to build and operate a new sea terminal for regasification of Liquefied Natural Gas (LNG). The terminal will be located near the Buenos Aires gas-distribution ring, specifically in the town of Escobar, around 60 km north of Buenos Aires city, on the shores of the Paraná de las Palmas river.

ENARSA and YPF are hoping that this new regasification terminal will contribute to minimising seasonal variations in the demand for natural gas, in addition to other projects that Argentina's Government is developing.

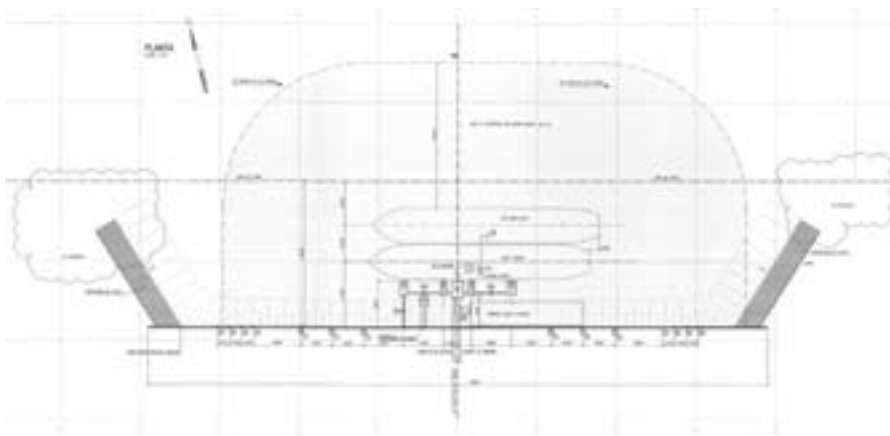
This project requires the design, construction, operation and maintenance of the facilities required to perform Ship-To-Ship (STS) operations that comply with all applicable international, national, shipping safety and environmental standards. The new terminal should enable the operation and maintenance of services

for simultaneous reception, storage and regasification of LNG on the shores of the Paraná river via a ship with capacity for up to 10 million m³/day, as well as the installation, maintenance and operation of a gas pipe connecting the dock to be built with the point at which the gas is delivered to the trunk gas pipe. It should be specified that the regasification step is performed on the actual ship during an initial stage, and a second stage includes building the regasification plant on land.

In this context, ENARSA and YPF summoned a group of companies specialising in technical aspects of the design and construction of LNG reception and regasification terminals, all with proven experience in the construction of this type of projects and in STS operations involving LNG, to participate in an invitation to tender. The aim of the invitation to tender was to find an engineering consulting firm that could fulfil the functions of Technical Advisor and Site Engineer.

Finally, in June, SENER was announced as the winner of the invitation to tender. It is currently in the process of carrying out the entrusted tasks, which will end with the commissioning of the new terminal, expected to take place before next winter in the southern hemisphere. ■■

In the image: scheme of the regasification terminal.





NEW VERSION OF FORAN

FORAN V70, new generation of CAD/CAM/CAE systems

FORAN V70, launched by SENER in November, represents a new generation of CAD/CAM/CAE systems for the design and production of ships and off-shore platforms. With innovative tools and improvements and developments in all its areas, FORAN V70 is the best solution to achieve the major challenge of reducing time and costs in a complex and global environment.

FORAN is leading the market thanks to a powerful development strategy, taking in consideration all user demands but also with a clear strategy based on innovation and continual progression. FORAN V70 incorporates great changes and small innovations that improve the functionality of the previous version.

COMMON TOOLS

FORAN V70 supports Unicode characters, which allows a real localization of the System. This new functionality enables entering text and generating production information in languages using non Latin characters, as Chinese,

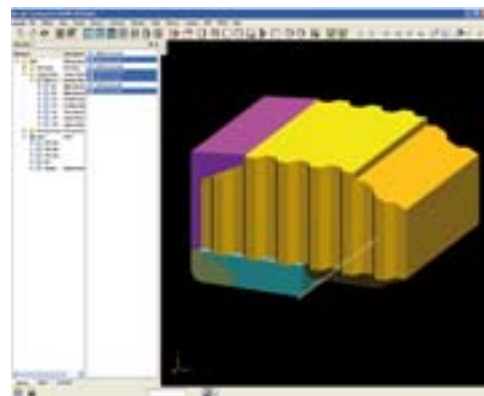
Japanese, Russian, Korean, etc. Moreover, FORAN dialogues and menu command names are translated upon demand.

A new virtual reality module FVIEWER replaces the predecessor VISUAL3D. This completely new walk-through application takes advantage of the latest graphic cards capabilities and allows the management of huge amount of data.

DRAFTING

An advanced 2D kernel, based in the QCAD application and fully compatible with AutoCAD, has been developed to be used in the module for the norms and standards definition (FNORM) and in the General Arrangement module (FGA) as well as in the future module for the definition of electrical and P&I diagrams.

In addition, some important developments have been added for the interim products drawings, the symbolic drawings and the 3D model views drawings generation with an important reduction of the time needed and the manual operations on drawings.



GENERAL DESIGN

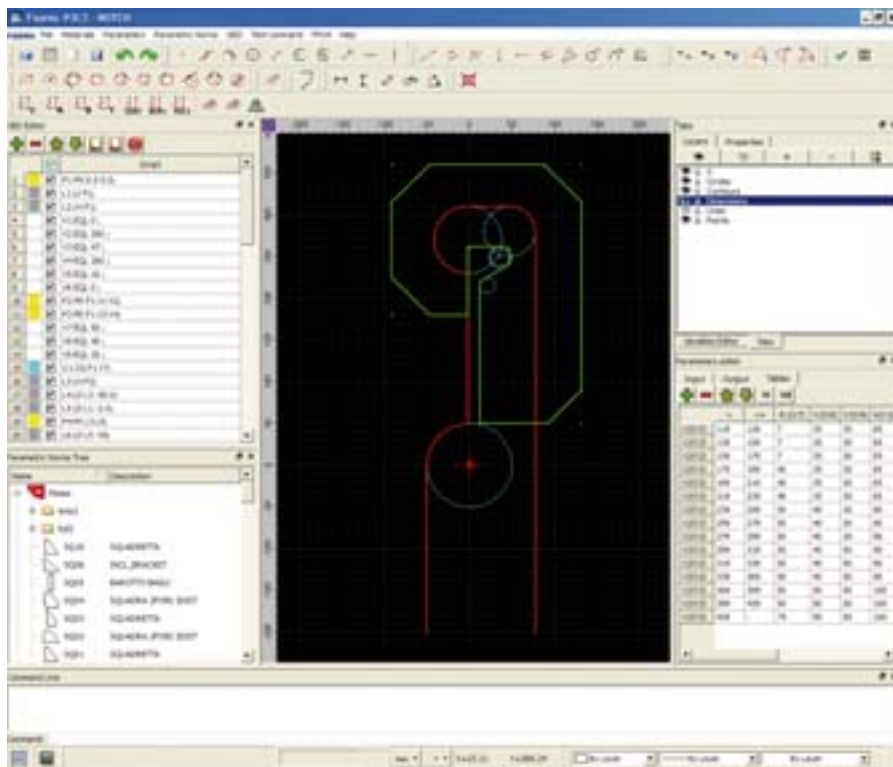
One of the major developments of the new version of FORAN is the new General Arrangement module (FGA) for spaces and general arrangement definition, both in 2D or 3D environments, with all data stored in the database and being possible to obtain the general arrangement drawing in an efficient way.

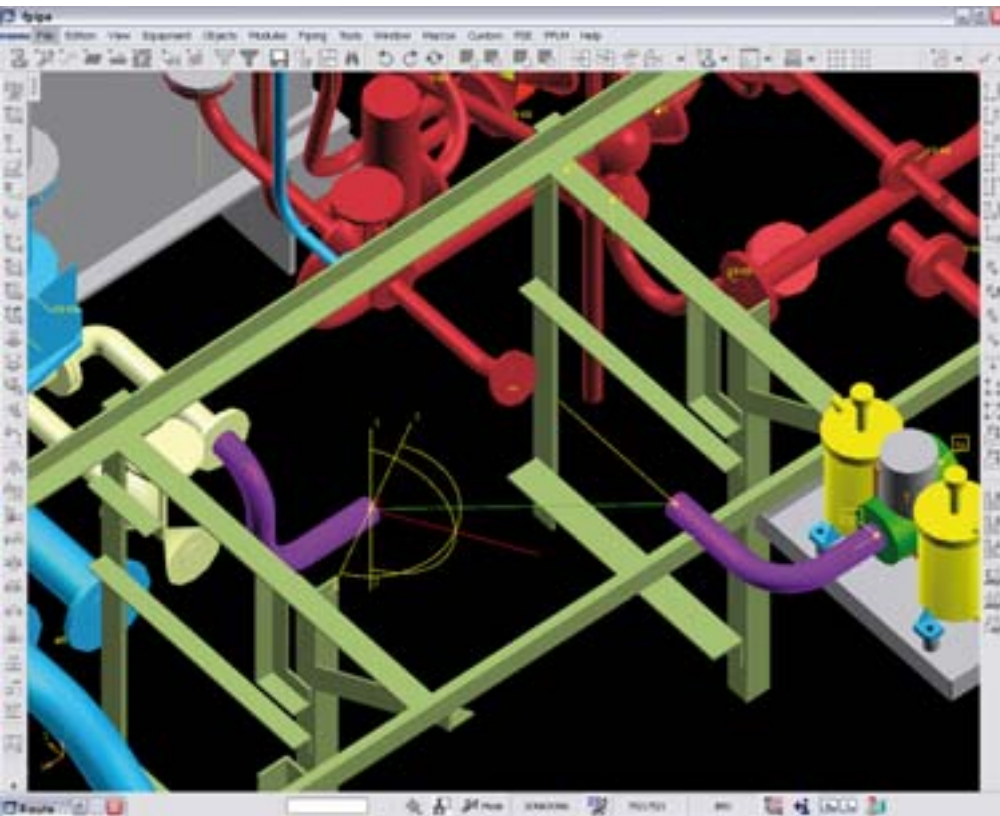
On the other hand, the module for the probabilistic damage stability calculations (FSUBD) offers now the possibility to consider intermediate stages of flooding, according to SOLAS Chapter II-1, Part B-1, Regulation 7-2, while the automatic assignment of spaces to subzones has been improved too.

HULL STRUCTURE

A new module FNORM has been developed to replace the previous NORM for the definition of standards of structure, with a new user interface, including multi dock windows, snap points, geometrical restrictions and a layer management. The increase of the lengths of the identifications and descriptions of blocks, materials and geometrical norms, and the hierarchical structure for the definition of the standards and geometrical norms are other new capabilities.

Important advanced features improve the hull structure modelling. As an example, the new modelling algorithm allows to represent corrugated parts more accurately thus improving the performance of the reading, recalculation and storing operations. New commands to allow an easy graphic checking of the edge preparation of plates and profiles, options for the definition of face bars at any angle with respect to the web supporting it and a modelling algorithm to represent more accurately curved



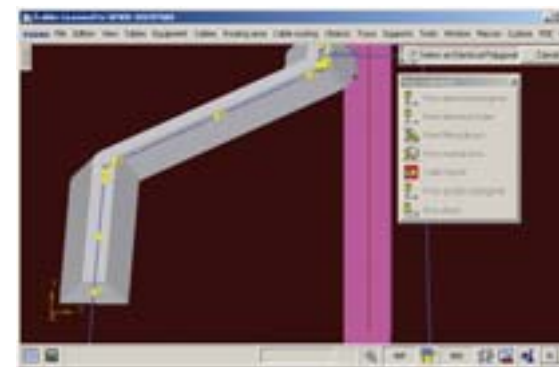


restrictions before generating drawings and greater flexibility for the creation of sets of piping elements.

ELECTRICAL

The electrical application in FORAN V70 allows the definition of a new built-in type of cable duct for special non-standard cross-section cableways. Other improvements are the ability to define conduits with cables inside cable trays and to consider them in the cross-section filling calculations.

The cable routing has also been improved, while the connection of cables and terminal blocks allows the management of cables partially routed.



PRODUCT LIFECYCLE MANAGEMENT

Finally, FORAN V70 allows the integration with different PLM Systems, thanks to a neutral solution built with standards based on XML, web services and CORBA. ■■

In the previous page, on the left: detail of the new module FNORM. *Right:* generation of a corrugated cargo hold in the new module FGA. *In this page, on the left:* detail of a pipe routing in FORAN V70. *Right:* detail of a non-standard section of a cableway.

shell and deck plates are other remarkable new capabilities.

Regarding profiles and plates nesting, the NEST module in FORAN allows now, under global build strategy nesting, the nesting of identical parts assigned to different interim products and keeps information to recognize each individual part.

FORAN V70 offers a revolutionary link for the intelligent connection between the model generated in FORAN and the different FEM tools. This application will be improved in futures releases.

MACHINERY & OUTFITTING

FORAN V70 incorporates a new generation of piping design tools to dramatically improve the pipeline routing

functionality of the system, with a highly interactive and friendly tool. Among others, some important characteristics are that auxiliary polygonals are not needed, pipelines are routed dynamically displaying the pipeline solid model and that snap points with significant points of the model are available. Users will benefit with automatic solutions provided by the tool and with the definition of complex layouts in a smart and fast way.

In addition, there are some other features for a rule and production based design, such as a new command for smart splitting of pipe segments based on the standard pipe length defined in the components library, new checking utilities to control the spool fabrication

ADAPTATION OF A BARGE

Port services workboat for Consulmar

SENER has adapted a barge that used to provide fish-farming services for Consulmar into a workboat to offer oil, water, cargo and antipollution services complying with MARPOL.

The barge, called 'El Faralló Dos', was initially designed and built to offer aquafarming services, more specifically for the transport of fry and adult fishes between the cages of the fish farm and the port. This transport was performed by means of four hoppers installed in the midship. The barge was fitted with all the machinery and services for handling fish, as well as for making the ice required to transport them between cages and port.

SENER was in charge of the project and management of the work

on the adaptation of the barge to offer MARPOL antipollution services, with a maximum collection capacity of 41 m³.

The workboat will also supply drinking water to boats, so the ballast tanks in the barge has been modified to comply with this new requirement. The barge's new freshwater transport capacity is 128 m³. The safety and fire-fighting systems have also been adapted in accordance with the Unmanned Engine Room Regulation. ■■



FORAN TECHNICAL SUPPORT CENTER

Harbin Engineering University in China will use FORAN

SENER has entered into a co-operation agreement with the Harbin Engineering University (HEU) in China, to provide licenses of its FORAN CAD/CAM System to the Digital Shipbuilding Laboratory of the University, for educational and research purposes. Located in the Chinese town of Harbin, HEU is specialized in shipping industry, ocean exploration and nuclear application.

Thanks to the agreement, a FORAN Technical Support Center has been set up at this Laboratory at the Beijing facility of HEU. The company United Force Corporation (UFC) has also participated in the agreement, as a partner of SENER for the distribution and technical support of FORAN in the Chinese market.

A complete FORAN package has been installed in HEU, with licensees of Hull forms, Naval architecture, Structure, Machinery & Outfitting, Electrical design, Build strategy, Virtual reality, Advanced design and drafting and Design change and access control. UFC has provided the necessary training in FORAN to the personnel of the University.

According to the co-operation agreement, the Technical Support Center will help introducing FORAN into Chinese Shipbuilding Industry and assist SENER and UFC in FORAN localization and customization.



FORAN is being implemented successfully in China, as this is in line with SENER's strategic plans for Asia. SENER wishes to promote the use of FORAN in China and will do the best to help them to improve the process of ship design and construction in the Chinese shipbuilding industry, and thus to enhance the competitiveness. ■■

In the image: detail of a ship section in FORAN.



ACERGY HAVILA VESSEL

A FORAN project nominated to Ship of the Year in Norway

FORAN has been the CAD/CAM system used for the engineering of the Acergy Havila Project, a new Diving Support Vessel (DSV) built after the agreement between Acergy and Havila Shipping in Norway. The Acergy Havila Project will be the state-of-the-art DSV specifically designed for efficient diving operations in the harshest environments. The vessel will have a length of 120 m, 23 m of beam

and will be fitted with a 250 t crane. Classified by DNV (Det Norske Veritas), the Acergy Havila will have high transit speed, an ice-class hull, class-3 dynamic positioning and be in compliance with the most demanding maritime and environmental regulations worldwide.

Havyard Steelcad has been the company that has developed the 3D engineering of the Acergy Havila Project,

using FORAN, a System that was implemented in the company in 1997. The ship has been nominated for the Ship of the year in Norway 2010.

Besides, as there were many companies involved in the project, different subcontractors have acquired the new FCM module, which is a FORAN solution developed by SENER for visualization and checking purposes. Those companies have been Havyard Design, which managed the ship design, the shipyard Havyard Leirvik, the operator and owner Acergy, the subcontractor for diving aspects Dräger Safety and the subcontractor Richter Rhorleitungsbau.

The FORAN FCM module is a tool for reading and querying 3D scenes or models defined in FORAN. Reading operation can be carried out either via online access to the database or through other specific files. The module also allows to import and export in different formats and, among others, can perform the following tasks: Commands to obtain points coordinates and distances, Access to all points of the 3D model, Functions to query the model, calculation of coordinates, weight and center of gravity, easy visualization options by using clipping planes, and options to apply transparencies to the objects in the scene. ■■

In the image: the Acergy Havila vessel, developed with SENER's FORAN System.



ENGINEERING FOR UNV

SENER is carrying out engineering services for eight tugs for **Unión Naval de Valencia**

SENER has been awarded with new contracts for Unión Naval de Valencia (UNV), that include engineering services in eight new tugs for different clients. These contracts strenght the close collaboration between the companies UNV and SENER, that began twenty years ago, and has allowed SENER to design and develop a wide variety of tugs and also other types of ship.

It is worth to mention that for all these projects, SENER has used FORAN, its own integrated CAD/CAM System for the design, engineering and production of ships.

FOUR NEW TUGS FOR THE AMBERES PORT

SENER is developing the engineering project of the contract awarded by UNV for the new four tugs for the Amberes Port, after it was put out to tender. Union Naval Valencia is a member of Boluda Shipyards, from Boluda Corporacion Maritima. SENER took active part in the preparation of the necessary technical information for the initial design for the public tender of the tugs, which was opened in 2008 with participants of most part of the best tug designers and shipyards over the world. Finally, UNV and SENER awarded the contract for the design, engineering and production of the four tugs.

The scope of the project developed by SENER includes naval architecture calculations, initial and basic design of structure and outfitting and security and fire-fighting, and finally the detail engineering of structure and outfitting using the CAD/CAM System FORAN, developed by SENER.

The main particulars of the tug, that will be built a series of four in the UNV shipyard, are a total length of 29,50 m, beam of 12,50 m, depth of 4,50 m, and draught of

3,00 m. The displacement will be 709 tons and it is classified by Bureau Veritas.

The estimated time to deliver the first of the tugs to the owner will be 14 months.

TWO AZIMUTHAL STERN DRIVE TUGS THAT WILL OPERATE IN PANAMA

Together with this contract, SENER developed the basic and detail design of structure and outfitting of both tugs, built by UNV, also for the Grupo Boluda ship-owner. The SENER project includes the development of the complete basic engineering of the ship, the definition of the 3D model and the generation of the information required for production and assembly, for which purpose it uses its own FORAN system.

It is a 6400 HP Azimuthal Stern Drive tug. Its main dimensions feature a total length of 30.50 m, a length between perpendiculars of 26.95 m, a molded breadth of 11 m, a depth of 5.80 m and a molded draught to the baseline of 4.70 m. The ship, classified by Bureau Veritas, will be able to deliver a bollard pull of 78 tonnes and will have a crew of six people.

The tugs are expected to operate in Panama in the harbor and at sea.

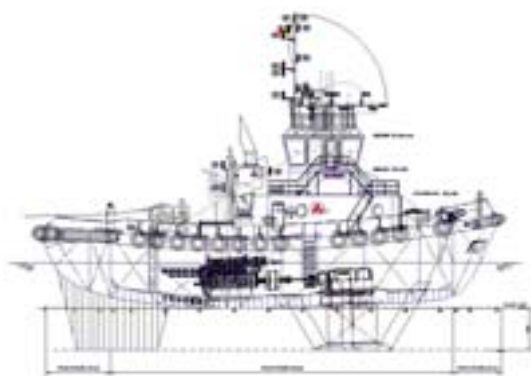
TWO TUGS FOR THE SHETLAND ISLAND COUNCIL

Finally, SENER has also performed the basic and detail design of structure and outfitting of a series of two twin tugs for the Shetland Island Council, built in the UNV shipyard. Both tugs, 'Solan' and 'Bonxie', will operate mainly in the Sullom Voe terminal and in the North Sea. This terminal is the largest oil-exporting port in the United Kingdom, with a volume of 25 million tons per year. The tugs will offer a towing and escort service.

The twin tugs have a total length of 40 m, beam of 14 m, a draught of 3.90 m, a speed of 14 knots and a crew of six people. They have a Voith-type propeller which delivers a bollard pull of 70 tons. The tugs are classified by Lloyd's Register.

The project developed by SENER includes the development of the complete basic engineering of the ship, the definition of the 3D model and the generation of the information required for production and assembly, for which purpose it uses its own FORAN System. ■■

In the image, above: voith type tug for the Shetland Island Council. **Below:** design of one of the tugs for the Amberes Port.



ENERGY AND ENVIRONMENT

SENER's technology in biomass and waste to **energy plants**

SENER's technologies increase energy efficiency and reduce the costs of generating electricity in biomass and waste to energy plants, thus achieving greater profitabilities. Emissions of CO₂ and maintenance costs are also reduced.

LIMITATIONS OF THE RANKINE CYCLE

The conversion of thermal energy from fuels into mechanical and electrical energy is normally carried out by the Rankine thermodynamic cycle.

The energy efficiency of the Rankine Cycle is greater the higher the pressure and temperature of the steam that drives the turbine. In power plants, temperatures and pressures above 500°C and 100 bars, respectively, are normal. These plants currently deliver electricity with gross efficiencies of 40 – 45%.

However, when the fuel is biomass or municipal solid waste (MSW), steam temperatures are limited by the corrosion produced by the combustion gases of these

materials. Steam must then be generated generally at temperatures below 430°C and pressures below 65 bars in order to obtain a reasonable duration of boiler tubes. In these conditions the gross electrical efficiencies of the Rankine Cycle are in the order of 26 – 28%

THE SENER THERMAL CYCLES

SENER has developed several thermal cycles for the generation of electricity from biomass and waste, which improve the energy efficiency of the Rankine cycle and reduce the corrosion produced by these fuels in boilers.

These technologies provide an additional boost to renewable energies, since they help increase the operating capacity and reduce costs. In addition, SENER's technology easily allows to surpass the minimum energy efficiency values established by the EEC legislation for MSW plants.

The new SENER thermal cycles are based on generating high pressure steam (around 100 bar) at moderate

temperatures (300 – 400°C). Under these conditions, the corrosion produced by the combustion gases of the renewable energies is substantially reduced.

APPLICATIONS IN MUNICIPAL SOLID WASTE

The SENER-4 process is highly suited to for waste to energy plants. It is based on a cycle with high-pressure steam at moderate temperature that is expanded in a turbine with reheating, which raises gross electrical efficiency to values of 32 – 34%. This technology only requires auxiliary fuel in start-ups. The SENER-2 process, based on a combined



cycle with auxiliary fuel (natural gas), raises electrical efficiency to values of 40 – 50% and is more profitable the greater the difference between the electricity price and the cost of the auxiliary fuel.

The SENER technology has been used in waste to energy since 2004 in the Zabalgarbi plant in Biscay (Spain), processing 240,000 t/y, and generating 100 MWe with an electrical efficiency of 45%.

APPLICATIONS TO BIOMASS

In the case of biomass, the SENER-4 technology can be combined with the SENER-1 process (overheating of the high pressure steam outside the boiler) or with SENER-3 process (combined cycle of biomass boiler with gas engine), which improve efficiencies up to above 35%.

SENER is currently developing a 27-MWe biomass project that includes the three technologies, achieving an electrical performance of close on 40%, which means producing 35% more electrical energy than would be generated with conventional technology. ■■

In the image on the left: the Zabalgarbi Waste to Energy plant in Vizcaya (Spain), with SENER's technology, is an international benchmark.



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CIVIL ENGINEERING

PUENTE DE ALCÁNTARA AWARD TO THE CONTRERAS DAM CROSSING FOR THE MADRID-LEVANTE HIGH-SPEED TRAIN



The San Benito de Alcántara Foundation has granted the Puente de Alcántara International Award to the viaduct over the Contreras Dam. The jury, presided over by Infante Carlos of Bourbon, highlighted the project's "use of novel execution techniques, the purity of its structural lines and the beauty and integration it achieves with the landscape".

The bridge is part of the contract for the project and technical assistance to the project management for the Minglanilla-Villargordo del Cabriel section of the Madrid-Castile-La Mancha-Autonomous Community of Valencia-Region of Murcia high-speed rail

line built for ADIF by SENER-GESTEC, with the collaboration of Javier Manterola for drafting the viaduct project. SENER also authored the informative study for this high-speed rail line and the corresponding environmental impact assessment.

The section crosses an area of rugged relief, which made it necessary to plan and build major infrastructure projects, including five tunnels with an overall length of 5,141 m and seven viaducts with a total length of 3,343 m. The most spectacular element of this section is the parabolic arch of reinforced concrete that crosses the dam, with a

261-m span and a rise/span ratio of slightly under one seventh, setting a new European record for a concrete arch railway bridge. Furthermore, since the area is of notable ecological value, the project was subject to many restrictions aimed at preserving the natural surroundings of the site.

For the development of this project, SENER-GESTEC received the collaboration of Oficina de Proyectos Carlos Fernández Casado, S.L. and construction was carried out by the temporary consortium of Azvi and Constructora San José. ■■

In the image: viaduct over the Contreras Dam.

INTERNAL AWARDS

CEREMONY OF THE INNOVATION AWARDS AND THE AWARDS TO SAFETY ON CONSTRUCTION SITES

On 15 July, SENER held the ceremony for its internal prizes: the Innovation Awards and the Awards to Safety on Construction Sites.

The Innovation Awards, which have a long history in the company, acknowledge products or processes with features or applications, from a technological point of view, that are substantially different from existing ones. This year, the awards went to the SENER team responsible for designing the SENERtrough cylindrical-parabolic solar collector. Its design has improved the technical and economic performance of existing collectors, thus achieving its goal of reducing the per-unit cost of power generation at thermosolar plants. This development was successfully completed in all its stages (design, validation and commissioning of the large-scale manufacturing and assembly processes) and the SENERtrough collector is now being

installed in commercial plants. For this reason, the company wanted to acknowledge the contribution of the team of engineers made up of Jesús Lata, Jorge Vázquez, Jorge Belletini, David Castañeda, Sergio Relloso, Nora Castañeda, Egoitz Larrabeiti and Iñaki Gila, who were responsible for this innovative development. On the other hand, the special mention at the Innovation Awards 2010 went to Miguel Domingo, Solar Business Director of SENER.

This year, for the first time, SENER gave Awards to Safety on Construction Sites. This is part of an initiative by SENER's management to reward the actions of those who make notable contributions to reducing accident rates on sites for which SENER is in charge of safety. In this first year, the awards went to Gonzalo Chapatte, José Luis Postigo and Honori Plá, for good practices at the head of the works for the Manure Treatment Plant of Polán and Consuegra (Toledo), the works for the BP Oil Co-generation Plant in Castellón, and the works for expansion of the power supply for Barcelona Metro Line 1, respectively. SENER's goal is to achieve a rate of 'zero' accidents by means of ongoing, gradual improvement of occupational hazard prevention on our sites. ■■

In the images, on the left: the winners of the Innovation Awards. *On the right:* the winners of the Safety on Construction Sites Awards.





HERSCHEL AND PLANCK

GRAND PRIZE 2010 OF THE FRENCH ASSOCIATION OF AERONAUTICS AND ASTRONAUTICS

The French Association of Aeronautics and Astronautics (AAAF) has awarded the Herschel and Planck satellites of the European Space Agency (ESA) the Grand Prize 2010 for 'outstanding space endeavours'. The award ceremony was held on 9 June at the Club l'Aero in Paris. This prize is given once a year in recognition of the project that has made the greatest contribution to the progress of science and space exploration.

Within the consortium of companies that participated in the mission, SENER was responsible for the complete Attitude and Orbit Control System (AOCS/GNC) of the Planck satellite and for some of the elements in Herschel's AOCS/GNC system that are common to both satellites. This system is responsible of locating the spacecraft at the required positions (orbit control), maintaining them with the adequate pointing and stabilization profiles (attitude control) and executing the desired orbital and attitude maneuvers,



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as well as correcting any possible deviations. The mission of the Herschel and Planck satellites is to collect information on the birth of the Universe. On the one hand, Planck studies the origin of the Universe by looking at radiation from the first radiation that existed in the Universe after the Big Bang, which still remains in space; on the other hand, Herschel researches how stars and galaxies were formed and how they are still formed today. ■■

In the image: Planck satellite.



SENER AWARDS AT THE UPC

SECOND SENER AWARDS AT THE SCHOOL OF INDUSTRIAL AND AERONAUTICAL ENGINEERING OF TERRASSA

The trophies and certificates of the 2nd SENER Awards for the best project in the Projects subject of the Industrial Engineering and Aeronautical Engineering degrees at the Polytechnic University of Catalonia (UPC) were awarded during a ceremony held on 28 June. These awards are a further sign of SENER's frequent collaboration with the UPC.

The award ceremony, held at the School of Industrial and Aeronautical Engineering of Terrassa (ETSEIAT), included the participation of the Head of the Mechanical Engineering Section of Barcelona, Íñigo Gurrea, and the Head of the Telecommunications Engineering Section of Barcelona, Óscar Julià. The winning project in the Industrial Engineering category was a plant for treating urban solid waste, while the award in the Aeronautical Engineering category went to the project entitled Supersonic Business Jet. A total of 71 students submitted their projects for the awards this year. ■■

In the image: the awarded students at the UPC.

CORPORATE RESPONSIBILITY

SENER RECEIVES THE PLAQUE OF HONOUR OF DESARROLLO Y ASISTENCIA FOUNDATION

The Board of Trustees of Desarrollo y Asistencia (DA) Foundation has awarded SENER a Plaque of Honour in acknowledgement of the support and help that the company has provided to this volunteer-based NGO from Madrid.

The eighth edition of the DA Plaque Award Ceremony was held on June 8, in a ceremony which acknowledged the contribution of volunteers and co-investigators, in the Museum of the City in Madrid. SENER's President, Jorge Sendagorta, picked up the award from the Chairman of Desarrollo y Asistencia, Rafael Izquierdo. SENER's was one of six Plaques of Honour awarded by the NGO this year. Moreover, at the ceremony 55 plaques were awarded to DA volunteers who, in 2010, celebrated five years of activity in some of its programmes.

SENER and the Desarrollo y Asistencia Foundation signed a collaboration agreement on June 22nd, 2008, to channel the voluntary work of SENER people through the Foundation, and the company also funds some of its projects. In that same year, the NGO awarded SENER the 'Mark of a Caring Company', which distinguishes its closest collaborators. Since then, the relationship between both organisations has grown.

The Desarrollo y Asistencia Foundation, which started out in December 1995, is a Charity and Aid Foundation whose core mission is to channel and foster solidarity through the promotion, training and coordination of volunteers to the benefit of underprivileged fellow citizens. It carries out volunteer programmes in hospitals, accompanying internal patients and supporting their relatives, leisure and free-time activities for the disabled, support programmes for homeless people and accompaniment programmes for the elderly, both at home and in residences. It is also a member of FEVOCAM (Federation of Volunteer Organisations of the Autonomous Community of Madrid) and REDAV (Network of Voluntary Action Organisations), of which it is currently the President. ■■



SPORTS MEDICINE

FUTBOL PLAYERS USE BIOSENER SYSTEM AGAINST SUDDEN DEATH

Former Real Madrid and Atletico de Madrid footballers tried out the BIOSENER[®] mechanism, which can monitor the vital signs of players at all times. Developed and patented by

SENER, is an efficacious tool for preventing sudden death.

The football players used it for the first time during the 'Corazón Classic Match 2010' charity match in favour of research into sudden death in athletes held in the Bernabéu on 30th May, between former Real Madrid players and Milan players. Ramis and Velasco wore 'intelligent' tops fitted with biosensors that measured the players' vital signs at all times during the match.

Since then, both the Atlético de Madrid and the Real Madrid teams test it in their facilities during trainings. Players such as Camacho, Reyes and Cabrera have already tested it.

The new belts are ergonomic and wireless, which means that they can be used during physical exercise without interfering in the players' activity. The device records and relays the players' vital signs, in real time, measuring their electrocardiogram, cardiorespiratory rate and temperature in different postures. This way it is determined the level of stress, tiredness, heat knocks, position and the physical status of the player, activating alarms and indicating the risk level.

This information is transmitted in real time to a phone, PDA or computer. The players of a team can thus be medically controlled from anywhere in the planet by their doctors and physical trainers, who are given detailed information on the vital signs of each and every one of the players during physical effort.

BIOSENER[®] is the only one of its characteristics certified as a medical device by the American FDA and the European legislation, which accredits that the measurements taken are medical-grade, making the system an efficacious tool for detecting anomalies such as those that cause sudden death.

This innovative system has been developed for the Spanish Army's 'Future Soldier' programme, and is currently used by armies from different countries, Technical Sports Centres and hospitals. ■■

In the image: a training of the Atlético de Madrid team with BIOSENER.

SOLAR TECHNOLOGY

SENER WINS THE US CSP TODAY AWARD

SENER has received an award in the first edition of the US CSP Today awards in the 'Best increased dispatchability solution' category.

SENER carried off this award thanks to its molten salt heat storage system, which enables plants with SENER technology to continue to produce power when there is no sunlight, either at night or when solar radiation is very weak. This system, which significantly increases the plant yield of plants without thermal storage, guarantees a continuous supply of electricity, overcoming intermittences, and renders it possible to flexibly adapt output to the demand for power, which is one of the main shortcomings of some renewable technologies.

The award was delivered on June 24th during the fourth edition of the Concentrated Solar Power Summit held between June 23rd and 25th in San Francisco (USA). The CEO of SENER's Office in the US, José C. Martín, picked up the award. After the event, he declared: "I am very proud of receiving, on SENER's behalf, the CSP Today Award that represents for us the acknowledgement to our continuous effort during the last ten years to turn the solar thermal power into a reliable technology, more and more competitive as time goes by, that allows to operate plants in a dispatchable way and with access to project financing". ■■

NEW PROJECTS

SIGN OF THE AGREEMENT IN THE METEOR PROGRAM

Last 21st July SENER and MBDA, a world leader in missiles and missile systems, signed an agreement for the participation of SENER in the multinational program of the air-to-air missile Meteor as design authority and supplier to MBDA of the FAS (Fin Actuation Sub-system).

The General Manager of SENER's Aerospace Strategic Business Unit, Rafael Quintana, signed the agreement with MBDA's Group Procurement Director, Simon Williams, accompanied by MBDA's Chief Executive Officer, Antoine Bouvier, and SENER's VicePresident, Andrés Sendagorta, the 21st of July 2010 at MBDA's booth during the Farnborough International Air Show. ■■

In the image, from left to right: Simon Williams, Rafael Quintana and Andrés Sendagorta during the signing of the agreement.





USA'S THERMOSOLAR MARKET

DOE CONTRACT FOR CSP INNOVATIVE THERMAL STORAGE SYSTEM

SENER has been awarded a contract by the US Department of Energy (DOE) for contributing to the development of the next generation of highly

efficient Thermal Storage Systems for Solar Thermal Plants.

This contract is covered by a DOE Funding Opportunity which's main objective is to improve the dispatchability of Solar Energy as well as to reduce its costs with the final aim of deploying utility scale baseload CSP plants in the future.

SENER leads a team which counts on the relevant contributions of the company GrafTech International Ltd. and the University of California at Berkeley, besides the support of potential key suppliers. HELSOLAR (High Efficiency Thermal Storage System for Solar Plants) project proposes to develop a high temperature solid storage concept based on the utilization of graphite. This concept will allow the implementation of energy storage capabilities in a wide range of CSP technologies, in a cost-effective way.

"This is an example of SENER's continuous effort in R&D and our commitment to provide more efficient Solar Thermal solutions" said Miguel Domingo, Solar Business Director at SENER. During the announcement of the awards, US Secretary of Energy, Steven Chu emphasized that "by investing in the development of low cost solar technologies we can create new jobs and pave the way towards a clean energy future". ■■

In the image: thermal storage tanks with molten salts system in a thermosolar plant developed by SENER.

NEW APPOINTMENTS

GUIDO CASANOVA has joined SENER's engineering and construction area



as head of Brazil. A Naval Engineer graduate from the University of Sao Paolo, he has previously been responsible for the business management of the Brazilian divisions of Pirelli Cabos S.A. and Pirelli Cables in Mexico, as well as managing the Brazilian division of Pirelli Telecomunicaciones and holding a number of managerial positions at Techint in Brazil and Italy. In his new post, Guido Casanova

will be responsible for consolidating SENER's presence in Brazil.

PIOTR REBAJN has been appointed as head of the Civil Engineering Section in SENER's Poland office. This appointment continues to strengthen the structure of the Poland Division with Polish



engineers with proven technical capabilities. Piotr Rebjan will be responsible for all the tasks of the Civil Engineering Section in the Warsaw office and will work closely with Engineering General Management (DGI, abbreviation in Spanish) and the Civil Engineering

and Architecture Strategic Business Unit.

ARGENTINA

SENER has restructured two key sections in the SENER Argentina Division, Piping and Processes, with the subsequent changes in management: The Piping Section, hitherto comprised of the Naval-Mechanics and Piping sub-sections, is divided into three independent sections, with new people in management posts:

ESTEBAN ROSIC will remain in charge of Piping, which will integrate the Design, Tensions, Materials



and Engineering Systems in order to gain efficiency and promote this specialty, which is fundamental to project development.

Marine will become a single section called Ship Engineering to keep the same name as the Madrid and Valencia



sections. This new Section will be managed by the Marine Engineer **MARCELO FANELLI** who has 23 years of experience in energy and processes, industrial and marine projects, and six years service in the SENER Argentina



In the Processes Section, **JULIO MARTÍNEZ**, creator of this Section in the Argentina Division, will take over the position of Process Consultant. SENER thus seeks to reinforce its capacity in nuclear energy, a field where Julio Martínez has accumulated great experience through his extensive participation in the National Atomic Energy Commission of Argentina.

Division, where he was the mentor of the Marine subsection.

JUAN SKRETKOWICZ will take over the Mechanical Section. A mechanical engineer with 40 years of experience, the last two at SENER, he participated actively in the Bicentenario combined cycle project from Bilbao and in the management of the 'Energy Optimization' project for YPF.



HORACIO JANER, a chemical engineer, has been appointed Head of the Process Section, with 20 years of experience, the last five of which have been with SENER in different projects in energy and refining plants.

OPTICAL SYSTEMS

High precision focused on planetary exploration

Knowing whether you are going to need an umbrella or seeing your house in a maze of streets on a gigantic map of the world are acts that have become part of our daily lives.

Complex optical systems that can zoom in on the Earth from the heavens have made this possible.

Pointing towards outer space, optical systems are fundamental in the achievement of complicated scientific missions that unravel the mysteries of far-off galaxies, or in providing crucial information on the origin of the Universe. They are systems that reach places the human eye cannot, and amplify the view from our planet to incredible levels. In national or international programs, sponsored by transnational institutions such as the European Space Agency (ESA) or the European Southern Observatory (ESO), optical systems have become

a key sector in civil and military technology. Spain, with SENER at the head, is beginning to stand out in the world scenario by virtue of its excellence in these projects.

The 1980s, the beginnings

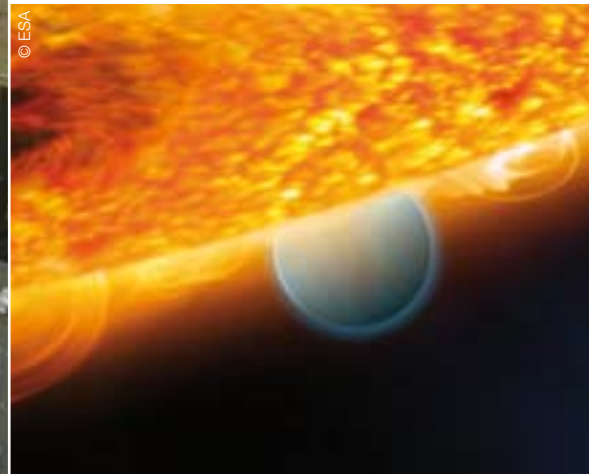
The field of optical systems is one of the most promising areas at SENER, and in recent years has witnessed a major development, particularly in flight equipment for space applications. But SENER's involvement in this field began with an important program carried out for the Spanish Ministry of Defense: the creation of a laser-guided missile, called the SBGL, which the company developed and successfully tested at the beginning of the 80s. The SBGL had a quadrant seeker whose effectiveness was demonstrated in real flying conditions. Its technology was much more advanced than that of other missiles of the time, such as the famous GBU-15.

In the 90s, SENER began to work on digital image processing, always in highly innovative fields such as image fusion or super-resolution. Equally noteworthy is the development of an image acquisition system in the visible and thermal spectra for combustion chambers in micro-gravity conditions for the ESA, as well as the LINZE project, which included the supply of an airborne camera on board an inspection helicopter for automatically recording the state of high-voltage lines in the visible and infrared ranges.

During this period, SENER also participated in different optical instruments for space applications as a supplier of precision mechanisms. It made the filter wheels and the refocusing mechanism of the FOC (Faint Objects Camera) that operated on board the famous Hubble telescope between

Below: view of the rich star formation region NGC 3603 and its massive compact central star cluster, an image taken by the Hubble telescope.



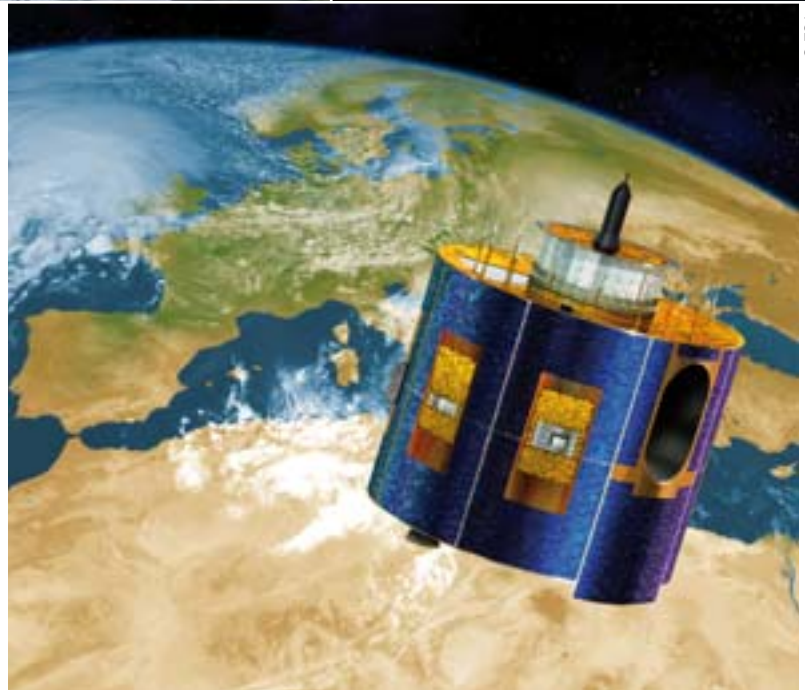


1990 and 2002. The refocusing mechanism makes it possible to correct the pointing of this camera with outstanding precision, enabling it to acquire images in the visible and ultraviolet spectra and to count individually the received light particles (photons). It recorded the first direct image of a star other than the Sun, the star Betelgeuse, also known as Alpha Orionis.

Consolidation in Space

These first contracts afforded SENER visibility in the field of optics for space applications, in which Spain lacked a specialized industry. Halfway through the 90s, the country began to study a national system for observation of the Earth that would permit the acquisition of images with applications in cartography, territorial planning, the management of natural resources and civil defense. These feasibility studies eventually took form as the National Territorial Planning Program, which included the SEOSAT/INGENIO satellite, and SENER was chosen as the company to supply the satellite's main payload, a high resolution camera with panchromatic and multispectral channels. As the projects progressed, SENER's optical instrumentation area gradually received new contracts.

The Gaia satellite, an ESA program for composing the greatest map of our galaxy ever known through two powerful telescopes, will also carry SENER equipment. The company recently delivered the flight model of the refocusing mechanism of the secondary mirror (called M2M), an outstanding piece of equipment that renders it possible to adjust these mirrors with enormous precision (5 degrees of freedom and movement resolutions of tens of nanometers). And in Meteosat Third Generation (MTG), the ESA satellite which provides meteorological information on Africa and Europe, SENER has manufactured a first prototype of the scanning mechanism of the Flexible Combined Imager (FCI), whose precision of movement is counted in tenths of seconds of arc. The FCI camera can

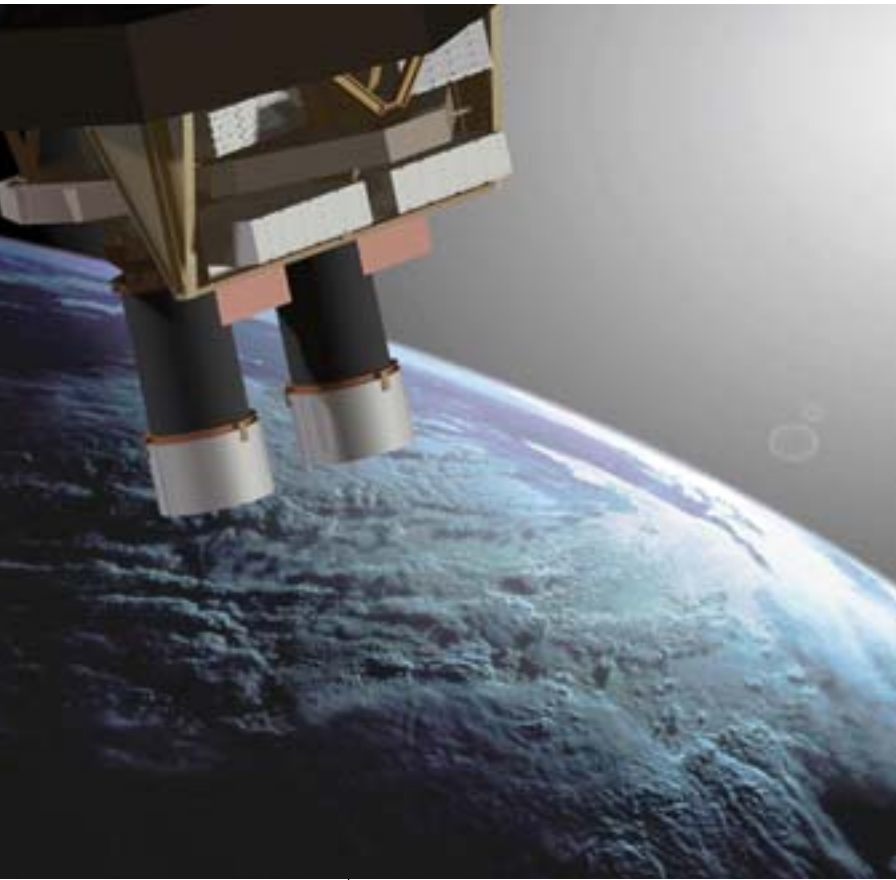


obtain images with higher radiometric resolution and greater precision in time and space of atmospheric conditions, cloudiness, humidity and fire, information which will help to provide more exact weather forecasts and to implement more efficient emergency action in the event of natural disasters, for example.

A present loaded with projects

Nowadays, SENER is the main contractor in optical instrumentation for scientific applications, particularly in the field of astronomy and astrophysics, both in image-formation systems and spectroscopy. In this field, the company is participating in the World Space Observatory - Ultraviolet (WSO-UV) project, a huge orbiting telescope whose scientific interest is comparable to the Hubble telescope's UV channels. SENER is the supplier of the ISSIS instrument (Imaging and Slitless Spectroscopy Instrument for Surveys), comprised of two high-

Above, on the left: Meteosat Third Generation's testing mechanism in SENER facilities.
Above, on the right: an artist's impression of the Jupiter-size extrasolar planet, HD 189733b, one of the investigation lines of the astronomers using the Hubble telescope.
Below: artistic view of the Meteosat Second Generation.



© ESA

Above: artistic view of the Spanish satellite for Earth observation SEOSAT/INGENIO.
Below: SEOSAT/INGENIO's optical instrument configuration developed by SENER.

sensitivity cameras capable of taking images in the far ultraviolet. The company is also performing a feasibility study for the thermal infrared radiation camera of the EUSO project (Extreme Universe Space Observatory) that will be installed in the Japanese experimental module of the International Space Station (ISS). This camera will be used to detect high-energy particles in space. Other astronomy projects in which SENER is involved are the E-ELT (European Extremely Large Telescope) being developed by the CSE, for which SENER has designed the HARMONI (High Resolution Monolithic Optical/Near Infrared) instrument, a spectrograph of the near infrared, or the SOL2 feasibility study for permitting the communication of spacecrafts in

deep space through laser-based optical links.

Of the ESA's planetary exploration missions, SENER is participating in the ExoMars mission exploring Mars. Specifically, the company is designing (among other projects) a spectrometer for the scientific payload of one of the rover vehicles that will be sent to the red planet to analyze samples of minerals and rocks from Mars. The Raman spectrometer will obtain information about the samples' structure and molecular composition. With its sights set on Mars, the company is participating in the development of the SOLID (Signs of Life Detector) instrument to discover signs of life on the planet by means of biological marker fluorescence detected by an optical system in field samples submitted to chemical processes.

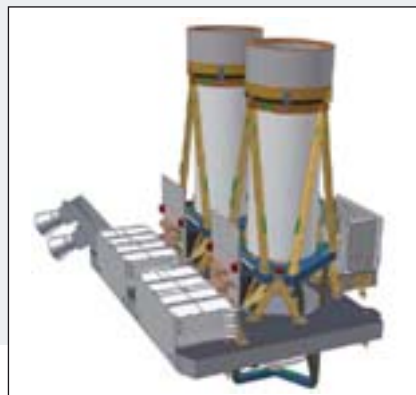
The activity of the optical systems group in space projects has also been reinforced with the recent incorporation of the NTE-SENER company, which specializes in precision mechatronics for astronomy. Excellent examples are the filter wheels for the OSIRIS multi-object spectrograph of the Canaries Great Telescope (GTC) and above all the alignment mechanism of the secondary mirror for this same telescope. At the same time, SENER's experience in military applications leaves the way open for new projects in this field.

Be they for scientific or military use, in land-based or space applications, the development of optical systems calls for non-stop investment in technological innovation. SENER, faithful to its culture and driven by the pursuit of excellence, continues to work to improve both the integration and validation of complex optical systems as well as video electronics design capacity, a fundamental area for controlling the features delivered by an optical system. The goal is to become a leading company on the national scene and, in the medium term, a relevant actor in Europe within the complex, high-technology field of optical-systems development. ■■

SEOSAT/INGENIO, THE KEY

PROGRAM. SENER has been selected to supply the main payload of the Spanish SEOSAT/INGENIO satellite, comprised of a high-resolution optical instrument in panchromatic and multi-spectral bands for cartography and remote detection applications. In this project, SENER has carried out the complete systems engineering and complete opto-mechanical design of the instruments, coordinating, in turn, the work of the consortium, comprised of THALES España (in charge of the electronic module) and INTA (in charge

of straylight studies and AIV of the instrument). The main payload is comprised of two identical cameras, with a resolution



of 2.5 m in the panchromatic channel and 10 m in each one of the four multi-spectral bands (R, G, B, NIR). Each camera covers a scanning width of 30 km, providing the 60 km required by the instrument, and is based on an optical design of the Korsch type, with a focal lens of 3.6 m and an aperture of 254 mm. The optical system, comprised of three on-axis conical mirrors, can provide images in the required spectral ranges, fulfilling very demanding conditions in terms of image quality (MTF) and signal-to-noise ratio.

*Poster in central pages.
Take it!*

"I see the universe getting a little bit smaller"

One way to see the future is to look at the stars. This is the only way to understand SENER's mission in aerospace engineering. That mission is to bring the universe within our grasp. Actually we have facilitated the flight of satellites and spacecrafts even before Man set foot on the moon. We have been conquering the heavens, carried by the wings of our aeronautical solutions. And we have come back down to earth to develop concentrated photovoltaic technologies and products, and defence and security technologies. And even make a deeper exploration of human beings possible due to our advances in medical robotics, expanding the possibilities of surgery.

The way to see the future. SENER Aerospace



SENER

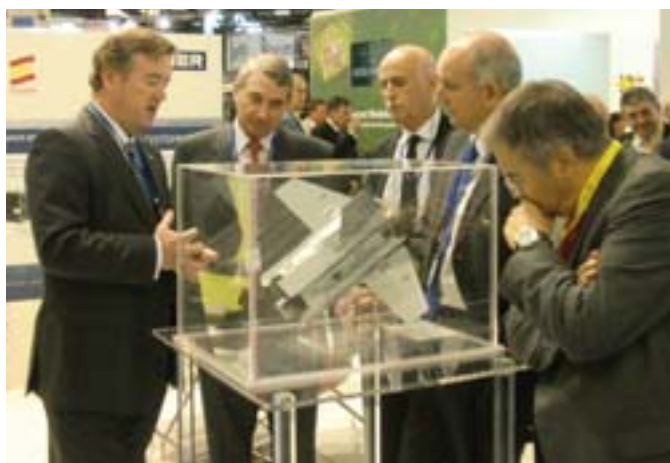
www.sener.es



The Minister of Industry, Power and the Environment of the Autonomous Government of Extremadura visits SENER

On 26 May, the Minister of Industry, Power and the Environment of the Autonomous Government of Extremadura, José Luis Navarro Ribera, visited SENER's offices in Madrid to discover, at first hand, the projects and technology currently being developed in the renewable power sector by the engineering group as well as by Torresol

Energy, a company devoted to the promotion, operation and maintenance of concentrated solar plants in which SENER holds a 60% stake. During his visit, the Minister was accompanied by the President of SENER, Jorge Sendagorta, and by the Chairman and the CEO of Torresol Energy, Enrique Sendagorta and Álvaro Lorente, respectively. ■■



Eurosatory 2010

Between June 14th and 18th the Eurosatory 2010 International Land, Airland and Homeland Defense Week took place in Paris. SENER took part in this event with its own booth inside the Spanish pavilion, showing its main projects in the aerospace and defense sectors, among them missiles such as Meteor,

IRIS-T, NSM and Taurus, and the BIOSEner non-intrusive real-time physiological status monitoring system. In the image, SENER Vicepresident, Andres Sendagorta, and the General Manager of SENER's Aerospace Strategic Business Unit, Rafael Quintana, explain some of these projects to the official delegation of the Spanish Ministry of Defense. ■■

Solar Paces 2010

SENER took part for the second time in the international trade fair of the concentrated solar power (CSP) sector SolarPACES 2010. At this new edition, which will take place in Perpignan (France) between September 21st and 24th, SENER gave three technical conferences on CSP technology and presented a poster. SENER engineers Jesús Lata, Sergio Alcalde, David Fernandez, Xabier Lekube, Sergio Relloso, Bosco Olabarri, Iñaki Zabala, Julio Blanco, Roberto Calvo and Yolanda Gutiérrez were responsible for these presentations.

SENER's active participation at this event, which is nowadays regarded as the leading world conference in the CSP sector, confirms its position as a leading technology company in this field. ■■

World Engineers Convention 2010

SENER, through its Division in Argentina, took part in the World Engineers' Convention, organized in Buenos Aires from October the 17th to the 20th, by the engineering associations UADI and CAI along with other engineering centres, schools and institutions from all over the country. SENER



has been showing its global capacities as an international engineering reference in the fields of Aerospace, Power and Process, Civil and Architecture and Marine Engineering, with growing importance in Latin America. ■■

Winner of 2010 COAVN Architecture Award

On July 2nd, the 2010 COAVN Architecture Award was awarded by the Official Basque-Navarre Architects Association at a ceremony held at Palacio del Condestable in Pamplona. The Director of SENER's Architecture Department, Juan Francisco Paz, and the architect from that same

department, Gloria Para, received the award, which was awarded to SENER in the 'Urban Design and Landscape' category for the San Roque Equipment Centre project. In the photo, from left to right, are Gloria Para, the Mayor of Portugalete, Mikel Torres, and Juan Francisco Paz with the award certificates. ■■





Inauguration of Bicentenario

On May 21st, the President of Argentina, Cristina Fernández de Kirchner, officially opened the Open Cycle stage of the Bicentenario Power Plant, located in the city of Pilar, in the province of Córdoba (Argentina), a project developed by SENER jointly with Electroingeniería. The new combined cycle plant will have an output of more than 500 MW and will guarantee the supply of electrical energy in the Argentinean province of Córdoba.

During the official opening, held at the plant's headquarters, Cristina Fernández de Kirchner stated that this investment "will permit a fairer development for the country" and that the work "will bring security to investors in industry



in the Córdoba province". The Electroingeniería-SENER consortium was commissioned with developing this turnkey project for the Córdoba's provincial energy company (EPEC). In the consortium, SENER

took care of all the engineering work, as well as joint management of the project, quality and the environment, cost control and management, the commissioning of the combined cycle, and offshore purchasing management. ■■

SEA 2010

NTE-SENER and SENER were present at the IX Scientific Meeting of the Spanish Society of Astronomy (SEA), held between September 13th and 17th in the head offices of the Spanish National Research Council (CSIC) in Madrid.

Both companies participated with their own booth, as sponsors, and offered a presentation of their activity in the field of astronomy by SENER's Space Director Diego Rodríguez, and the NTE-SENER Commercial Director, Francesc Gallart. Each company gave also a scientific presentation, by the engineers Joan Manel Casalta, from NTE-SENER, and Rafael Rebolo, from SENER. ■■

Inauguration of the new football stadium in Krakow

On September 25th, the new MKS Cracovia Football Stadium, a SENER project, was officially opened. The event was organized by the



Krakow City Hall, with the presence of the President-Mayor of Krakow, Jacek Majchrowski, and the Minister of Sport, Adam Giersz, on behalf of the Central Government, as well as representatives from the companies Estudio Lamela and SENER, both authors of the project. After the opening, the first football match took place, between the Cracovia and Arka Gdynia teams. In the image, a moment of the football match during the opening ceremony. ■■

Trade fair for transport technology Innotrans 2010

Between September 21st and 24th INNOTRANS 2010, the biggest international

trade fair for transport technology innovative components, took place at Berlin. SENER, that has an important activity in Aeronautics and Vehicles for rolling stock design, has participated with its own booth, where it has showed its main projects in railway technology. ■■

EFEF 2010

SENER leadership in solar technology was shown again during one of the main renewable energies event in Europe, EFEF 2010, that this year took place in London between October 19th and 21st. Both SENER and Torresol Energy, the company for the promotion, exploitation and maintenance of CSP plants owned by 60% SENER, took part at the EFEF. With 15 plants amounted, SENER leads the CSP technology market for number of projects developed. Besides, Torresol Energy is in the last stages of construction works of its innovative projects, among them the first commercial plant in the world with molten salt technology, Gemasolar, that will start operation in 2011. Both companies shared will a 60 sqm booth where Gemasolar's technology was represented with a big tower in the center



of the exhibiting space. SENER's CCP technology, the SENERtrough system, was also shown. This system is applied in Torresol Energy's Valle 1 and Valle 2 projects. Besides, the Chief Financial Officer of Torresol Energy, Manuel Fernández, took part in a conference on Thursday 21st about storage systems for CSP plants.

In the image, the Chief Infrastructure Officer of Torresol Energy, Santiago Arias, shows the main projects of both companies to the Secretary of State for Energy, Pedro Marín, accompanied by other political delegates. ■■