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Issue 3

HARAMAIN
High-speed rail in Saudi Arabia

RAILWAYS
Antioquia sees the return of the train

ARCHITECTURE
A steel cube to control it all

AERONAUTICAL
A single sky for everyone
+Q&A with Roberto Kobeh, President of the ICAO Council

TRANSPORT STUDIES
Revitalising transport in Costa Rica

SUSTAINABILITY
Mankind and water

Editorial

A Spanish-Saudi consortium being awarded the contract for the construction of the high-speed line between Makkah and Madinah is a historical event for Ineco and Spanish engineering.

The contract, which includes the assembly, equipping, operation and comprehensive maintenance of the line during 12 years, is also an international recognition of Spanish expertise in advanced rail technology; an excellent political, technical and economic commitment that, since the commissioning of the Madrid–Seville high-speed line almost 20 years ago, has continuously grown and consolidated. Today, the Spanish high-speed rail network is an unquestionable success, and the confidence that the Kingdom of Saudi Arabia has placed in our technology is a source of great pride.

The strategic importance of this project is a starting point for creating new opportunities in a region where Spanish engineering firms have much to contribute. We would like to dedicate this issue of itransporte English Edition to a feature on the important challenge ahead of us, and take this opportunity to thank all our partners in the consortium for participating in this edition.

This issue also includes two interviews with key figures in the aeronautical sector: Miguel Ángel Oleaga, director of Madrid-Barajas International Airport, and Roberto Kobeh, President of the ICAO Council.

As head of the 12th largest airport in the world, Oleaga has faced the challenge of a €6.3 billion extension that has seen the airport double its capacity, catering now for up to 70 million passengers each year. For his part, Kobeh responds to our questions regarding the future goals of the ICAO, the most important organisation responsible for the security and harmonization of the world's air transport network. Ineco's participation in ICAO's programmes is also one of the many features that are covered in this new issue, which we hope you will find to be of great interest.

IGNASI NIETO
Chairman & CEO of Ineco

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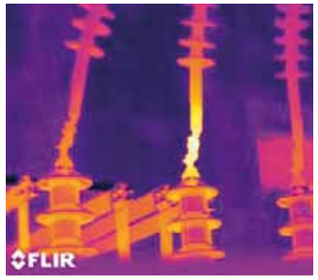

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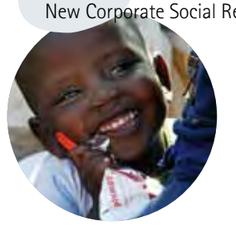

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Cover picture: Foster+Partners

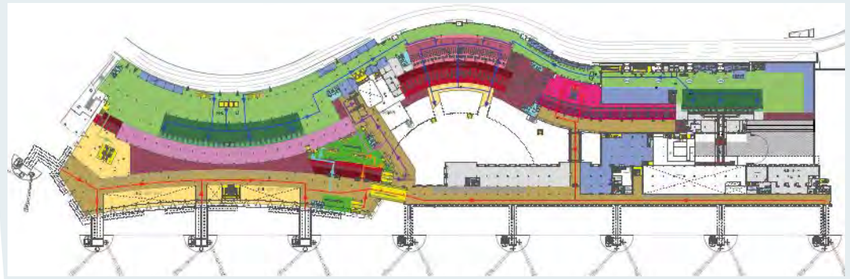
International news

Ineco in the global air navigation services association

Having received the corresponding certifications as AFIS and ATC service provider in 2011, Ineco has joined CANSO (Civil Air Navigation Services Organisation), which represents the entities that manage 85% of the world's air traffic. CANSO was set up in 1997 and has over 100 members and associate members on the five continents, including AN service providers, companies linked with the air sector, national civil aviation authorities, airport operators and manufacturers, such as Boeing and Airbus. Aena, founding member of the organization, Indra Sistemas and now Ineco make up the Spanish members in the association. Furthermore, Madrid will host the CANSO World ATM Congress in 2013, at which 5,000 participants are expected to attend.

>SULTANATE OF OMAN

Easement study of the new Muscat control tower



The Sultanate of Oman has commissioned Ineco to revise the aeronautic study of the new control tower at the Muscat Airport. The study seeks to analyse data on the surfaces containing obstacles to ensure aeronautic safety of aircrafts during operations (manoeuvers, take-off, etc.) in the area around the tower.

The construction of the new tower, which will be the highest in the country at 100 metres, forms part of the plan to extend the airport that is expected to be finished in 2014.

>MOROCCO

Technical assistance at Mohammed V International Airport in Casablanca

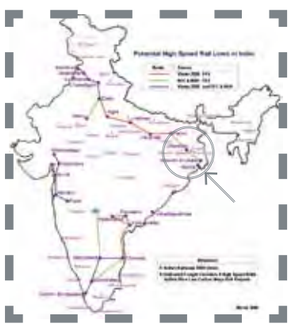
After performing the functional study of the new airport terminal, Ineco will continue the work started in January 2011 at the Mohammed V International Airport in Casablanca, as it has also been commissioned to carry out the second phase of the project. This new phase involves providing technical assistance in the development-engineering phase of the airport's terminals. Among other aspects, the company will be responsible for providing support during engineering and architectural tasks, ARC Port simulations of passenger flow in the terminals, the advanced basic BHS project, as well as in drafting the commercial development plan of the terminals.

>INDIA

Study for the Haldia-Howrah high-speed corridor

Ineco, together with Prointec and Ayesa, will perform the pre-feasibility study of the future 135-kilometre corridor that will link the port city of Haldia with Howrah, located in the metropolitan area of Kolkata, in the northeast of the country. The work includes the execution of demand studies, section proposals, rolling stock and a preliminary cost estimate that will determine the technical and economic viability of the project.

The Indian Ministry for Rail Transport has commissioned viability studies for the first six corridors that will connect the main urban nuclei of the country at speeds of between 250 and 350 kph. Currently studies are underway for the Pune–Mumbai–Ahmedabad (650 km), Delhi–Chandigarh–Amritsar (450 km) Delhi–Agra–Lucknow–Varanasi–Patna (990 km), Delhi–Agra–Lucknow, Hyderabad–Vijaywada–Chennai (665 km) and Chennai–Bangalore–Coimbatore–Ernakulam (650 km) corridors, as well as the Haldia–Howrah stretch.



>ESTONIA

Improvement works on the Tallinn tram

Line 4 of the Tallinn tram shows major demand, with high occupancy levels at rush hour. To increase its capacity and improve the quality of the service, the Tallinn tram company will rebuild the line and acquire new rolling stock. To do so, it has received funding from the Spanish Ministry for the Environment, Rural and Marine Development (MARM) and the European Union.

Ineco will develop the preliminary design (drafting instructions) and the specifications of the works involved in the line and those required for acquiring new rolling stock. In the picture, a team from the company during one of its meetings with those responsible from the Tallinn city council and the operator of the tram network in the capital of the Baltic country.

>COLOMBIA

Ineco to design the Eldorado Airport control tower

Aerocivil (the Colombian Civil Aviation Authority) has commissioned Ineco to perform studies and designs for the new control tower at the Eldorado International Airport. With a budget of approximately €500,000, the project will define the type of control tower required by the airport terminal, the equipment needed and the cost of work. Aerocivil plans to start works by the end of 2012, both on this new building (which will replace the current one), and on the future passenger terminal (picture above). The picture to the right shows Javier Cos, General Manager of International Development at Ineco, together with Sergio Paris, Director of Aerocivil, on signing the contract.

AERONAUTICAL STUDIES

New contract with the Latin American development bank

CAF (Latin American development bank) has awarded Ineco the contract to perform the evaluation of air connectivity between Latin-Arch Forum countries and Asia-Pacific. Ineco has already performed the ASAND study for CAF, which analysed operational and technical aspects of the most important airports in the Latin-Arch Forum countries. The new study will look at existing airways between these countries, as well as airways between Latin America and Asia-Oceania, advancing air transport in such a way to contribute the region's development. CAF is formed of 18 countries from Latin American, the Caribbean and Europe, as well as 14 private banks from the Andean region.

>NORWAY

Air navigation procedures

Ineco, together with NATS and CGx AEROinSYS, has been awarded a contract in conjunction with the Norwegian air navigation service provider (AVINOR) to design flight instrument procedures in the airports AVINOR manages. This way, AVINOR will comply with the directives of the *Single European Sky*, designed to ensure efficient use of continental air space by reducing the costs of flights, air navigation services, flight times and pollution. AVINOR also plans to reduce its control centres from three to one (to be put into operation in 2017).

International news

CONTRACT

>UKRAINE

Design and supervision of the construction of a new airport terminal in Odessa

Odessa Airport Development, concessionary company of the Odessa International Airport has commissioned Ineco to perform the project drafting and supervision of the works involved in the new passenger terminal. The project is being developed as part of an ambitious renovation plan, which includes the remodeling of the current airfield.

The new terminal building, which is expected to be finished within 18 months, will increase the capacity of the airport to 4 million passengers each year. Located 7.5 kilometres from Odessa, the airport is connected with more than 60 cities around the world and has 110 regular flights each week.

OPENING OF A 150-KILOMETRE CORRIDOR

The Spanish high-speed network incorporates a new line

The corridor that joins the Galician cities of Ourense, Santiago and A Coruña involved the construction of a new section between Ourense and Santiago, as well as works to adapt the rest of the line. The corridor was opened in December 2011. Ineco has participated in the project by carrying out different tasks during the construction of the section, which involved building 30 tunnels and 18 viaducts.

Ana Pastor appointed Spain's new Development Minister

On November 21, Spain's new Prime Minister, Mariano Rajoy, presented his cabinet. Ana Pastor, former Health and Consumption Minister from July 2002 to April 2004, has been appointed new Development Minister. Graduate in Medicine and Surgery from the Universidad de Salamanca and a Civil Servant in the Higher Board of Public Health and Healthcare Administration, Pastor was in recent years Deputy Vice-Chairwoman of the Spanish Parliament, Member of Parliament for Pontevedra and Coordinator of Social Participation for the Partido Popular.

>CONSULTANCY SERVICES FOR THE COLOMBIAN SANTIAGO VILA AIRPORT

Santiago Vila Airport, located in Flandes-Tolima, will be modernised to carry out cargo operations. This airport will complement goods traffic at the Eldorado Airport in Bogotá. Coffee, flowers and electronic components are some of the key products of the region that are transported by air. The authorities seek to strengthen their export with the expansion of this new airport, at which Ineco will perform consultancy tasks.

Collaboration with Honduras

Ineco and Honduras have signed a framework collaboration agreement for transport infrastructures, which will last 28 months. The Honduran government will take advantage of Spanish experience to improve its transport system and boost development in the country. The actions planned cover all public modes of transport: air, rail, sea and road networks. The main collaboration activities include exchanging experiences and technology transfer, supporting the development of the appropriate legislation, designing and executing in conjunction programs, plans, studies and projects, as well as activities for its management and pre-investment plans. In this way, Ineco strengthens its presence in Latin America.

>ADVISORY SERVICES IN COSTA RICA

The Costa Rican government has commissioned Ineco to draft an institutional diagnosis, prepare a strategic plan and modernize the structure of its CETAC (Civil Aviation Technical Council) and the country's Directorate-General of Civil Aviation. The company will carry out a comprehensive diagnosis to understand the current operation of its authorities, as well as the applicable legislation and the situation of the sector. Furthermore, it will propose a strategy with a new organizational model, adjusting the operational model and defining a new model for managing and organising the relationships between the new areas of the company.

>NATIONAL TRANSPORT PLAN FOR ECUADOR

The Ecuadorian Ministry for Transport and Public Works has commissioned Ineco to draft its national transport strategy. With a view to driving foreign trade, Ecuador looks to improve its infrastructures, as well as boosting the connection between different modes of transport. Javier Cos, General Manager of International Development at Ineco, and David Mejía, Vice-Minister of Ecuadorian Management and Transport, signed the contract in October 2011.

Haramain: high-speed rail in the desert

Ineco is in the winning consortium for the future Makkah–Madinah line

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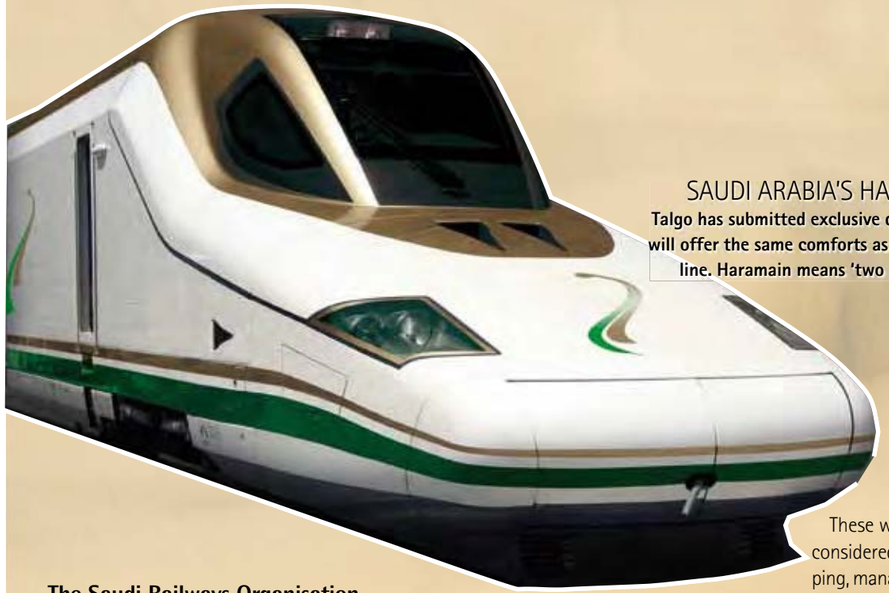
444km



SAUDI ARABIA'S HARAMAIN TALGO

Talgo has submitted exclusive designs to the SRO, which will offer the same comforts as any European high-speed line. Haramain means 'two holy places' in Arabic.

The Saudi Railways Organisation (SRO) has just awarded the Spanish-Saudi group Al Shoula the contract for the second and final phase of the Haramain High-Speed Rail Project (HHR), the first high-speed line in its network. The contract includes assembly, equipment, operation and comprehensive maintenance for a period of 12 years.

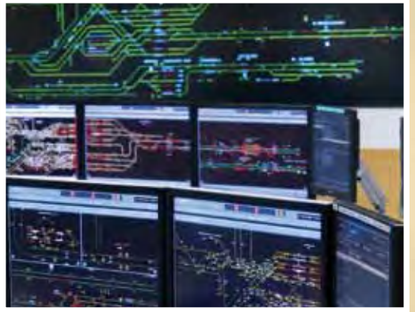
The latest technology will be used on the high-speed line promoted by the Saudi Railways Organisation (SRO), which will link the two holy cities in the Muslim world, Makkah and Madinah, in Saudi Arabia. Each year, millions of pilgrims will be able to travel the 444 kilometres separating the two cities in less than three hours, while enjoying the finest modern conveniences.

The characteristics and climate of the surrounding area, as well as the enormous demand expected, pose major technical challenges: dust and sand storms, large temperature variations, shifting dunes and passenger volumes that could reach 160,000 daily, one of the highest in the world.

These were the major conditioning factors considered in the winning proposal for equipping, managing and maintaining the Haramain High-Speed Rail Project (HHR) for a period of 12 years. The HHR is one of the most ambitious high-speed rail projects in the world.

The SRO is financing the entire project, with an investment of over €12 billion. More than half of that amount has been allocated to this final phase of construction and commissioning, which has just begun. Ineco will lead the consortium of companies, with majority participation from Renfe Operadora (responsible for commercial operation), Adif (in charge of technological integration and maintenance management, as well as train movements and stations) and Talgo (rolling stock supplier).

The Spanish partners point out the important opportunity that this contract represents for intensifying their internationalisation processes and value the implicit recognition of their technological expertise in high-speed rail. Opening new markets is precisely one of Renfe's strategic targets for the next two years, as president Teófilo Serrano recently explained: "Our business objective is to become a leading operator in Europe and the rest of the world... We believe that we are capable of successfully operating an efficient system in any country."



Antonio González Marín, president of Adif, highlights the relevance of the project for the Spanish companies, due to its economic volume and as an excellent showcase for future projects. "It would also be our first experience building a high-speed line abroad. Our point of reference is the Spanish network, which is one of the most advanced in the world."

PROVEN TECHNOLOGY

The SRO wants a high-speed line with proven, state-of-the-art technologies, such as Level 2 ERTMS.

The winning consortium has 88% Spanish participation. In addition to Renfe, Adif (the "systems integrator" for the project) and Talgo, the consortium is comprised of the engineering and consultancy firms Ineco and Consultrans, the IMATHIA group (promoter for the consortium and responsible for the alliance with the Saudi partner for which it is named), the construction companies OHL, Copasa and IMATHIA (in charge of civil engineering works), Dimetronic (signalling, train protection systems, centralised traffic control and track apparatus), Indra (telecommunications network, Control Centres, security, remote surveillance and ticketing), Cobra and Inabensa (which are responsible for electrical power, along with OHL). The Saudi partners working with the Spanish companies are the Al Shoula industrial and financial group, as well as the local construction firm Al Rosan.

The SRO expects the Haramain to be finished in late 2014 to carry some of the 8 million pilgrims visiting the two cities, particularly during the *Hajj* (great pilgrimage), which takes place annually on dates that vary according to the Muslim calendar. In addition to the two terminus stations, Makkah and Madinah, the line will have three other stops: two in Jeddah (central

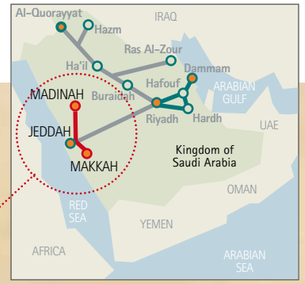
➔

The Saudi Railways Organisation is financing the entire project, with a total investment of over €12 billion (almost $16,2 billion).

→ and airport) and one in the King Abdullah Economic City (KAEC), which is being built in Rabigh. This is a residential, industrial and commercial macrocomplex covering 168 km², in which the Saudi government will invest over €21 billion. Jeddah Central station will also be the connecting point between the HHR and the Land Bridge, an east-west axis crossing the country to the capital, Riyadh, and the ports of Dammam and Jubail.

'Ad hoc' technical solutions. Future HHR passengers will enjoy the same comforts and technical standards already present on Spain's high-speed lines, although designed to accommodate Saudi Arabia's climate and terrain and the high traffic predicted: double European-gauge track with Level 2 ERTMS (European Rail Traffic Management System), commercial speeds of 300 kph and last-generation rolling stock, control systems, etc., requiring particularly frequent and exhaustive maintenance, in addition to *ad hoc* technical solutions.

The tendering conditions also established that the proposed components, equipment and systems must already be proven and in commercial use, although they could be customised for the HHR. This is the case of the Talgo trains. As far as commercial operation is concerned, 18 years of high-speed rail experience worked in favour of the Spanish-led consortium, which was the sole finalist along with the Franco-Chinese group Al Rajhi, which was awarded another contract for the first phase of the project. ✱



A GROWING NETWORK

Saudi Arabia has 1,392 kilometres of railway lines, connecting Riyadh, the capital, to the cities in the east. The SRO expects the network to multiply over the next few years with several projects, in addition to the HHR. One is the Land Bridge, to cross the country from coast to coast, and a future north-south line.

Demand forecasts

One of the most unique aspects of the HHR project is the huge level of passenger demand predicted by the promoters, who expect around 160,000 passengers daily. However, the SRO calculated that demand during the 'Hajj' (great pilgrimage) could be even higher. All elements of the project are being adapted to the high traffic intensity predicted, from the maintenance schedules –much stricter and more frequent than usual– to the materials and equipment used in the construction, which must be particularly robust. The consortium's bid guarantees that the proposal completely satisfies these requirements in terms of construction and equipment, general maintenance of tracks, trains and installations, and commercial operation management.

✱ The railways are one of the Saudi kingdom's main infrastructure priorities. It recently approved the financing for another major railway project: the east-west axis that will link Jeddah to Riyadh, known as the Land Bridge. This 959-kilometre line will be used to transport passengers and freight between both coasts, as it will connect to the existing line between the capital and the port of Dammam. In addition to these projects, the longest line of all will be a north-south corridor (about 2,400 kilometres long).

Recognised effort


1


2


3


4

PICTURES OF A WINNING BID_[1] Ineco drew up the technical proposals and Consultrans was responsible for the economic-financial model, legal-commercial aspects and coordination, along with the legal services of Herbert Smith, the contracts and final bid, submitted on July 3, 2010, at the SRO offices in Dammam. [2] The SRO president, Abdul Aziz Mohammed Al Hokail, receiving the documentation, contained in five Arabian-style inlaid boxes (which Ineco ordered from an artisan in Granada). [3] Osama Salama, Finance Manager for Al Shoula (left), with Mamukoya Tharamal, an engineer from the group. [4] Javier Cos, International and Business Development Manager for Ineco (right), with representatives from the Al Shoula group.

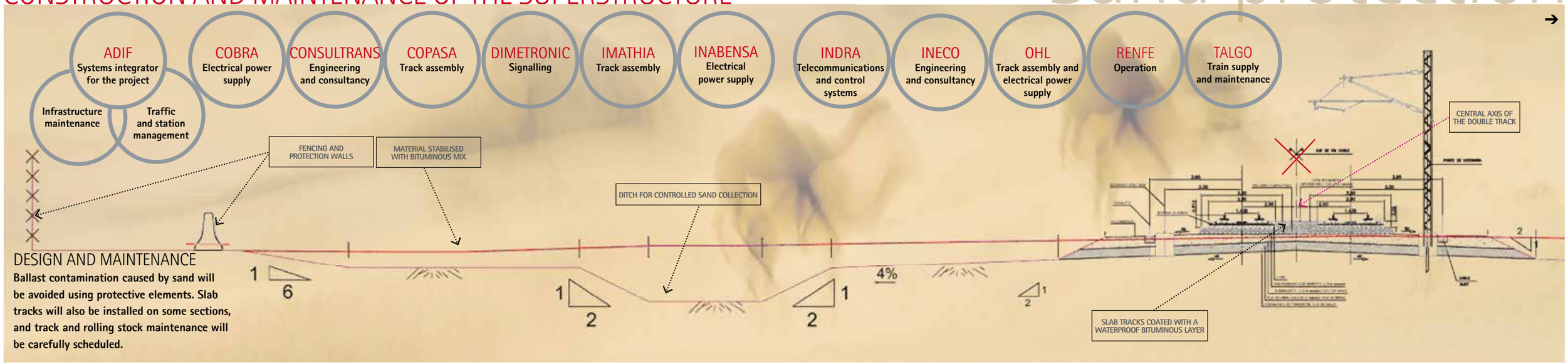
OFFICIAL PRESENTATION_Above, consortium representatives during the presentation of the project, convened by the Spanish Ministry of Development on October 27, 2011, one day after the SRO announced the successful bidder for the international tender. Former Minister José Blanco thanked the Saudi authorities for 'the trust placed' in the Spanish companies, which he congratulated.

NEW PRESIDENT_Below, Javier Cos, International and Business Development Manager for Ineco, with Manuel Benegas, new president of the Spanish consortium and Operations Manager for Ineco.

The design includes specific sand collection areas, protection walls for controlling sand accumulation and the installation of slab tracks.

Sand protection

CONSTRUCTION AND MAINTENANCE OF THE SUPERSTRUCTURE



DESIGN AND MAINTENANCE

Ballast contamination caused by sand will be avoided using protective elements. Slab tracks will also be installed on some sections, and track and rolling stock maintenance will be carefully scheduled.

>MANUFACTURE AND SUPPLY OF THE ROLLING STOCK

Talgo

Talgo will supply the trains, which will feature the same technologies as the Spanish AVE, though with certain characteristics adapted to the SRO requirements. They will be composed of two classes: Tourist and Business. The interior and exterior styling, as well as the high-end finishes, will be designed exclusively for the line. "The HHR project represents an unprecedented challenge for Spain's railway industry, where our technical, technological and export capabilities will be proven in the world's most important railway project," said Carlos de Palacio, president of Talgo. "The Talgo 350 Haramain high-speed trains supplied by Talgo will include the latest technological advances and will offer features and performance that are unique on the market in terms of weight, accessibility, energy consumption, comfort and safety. This project consolidates Talgo's position as the Spanish leader in the design, manufacture and maintenance of high-speed trains, and as a clear leader at a global level."

>ENGINEERING AND CONSULTANCY

Ineco and Consultrans

During the construction phase, Ineco will be in charge of drawing up and managing the basic and construction projects for the superstructure (electrification, catenary, etc.), in addition to environmental management and technical assistance. Consultrans, on the other hand, will coordinate all financial, legal and administrative aspects of the Saudi "specific-purpose corporation" that will be created to implement the project. This company will also conduct the demand study that will establish the rate policy and operations plan, and will carry out environmental monitoring of the site and health and safety coordination.

>TRACK ASSEMBLY

OHL, COPASA and IMATHIA

The nearly 450-kilometre line will be assembled on a UIC-gauge (1,435 mm) electrified double track, on ballast with sections of slab tracks, for which the installation of the RHEDA 2000 system has been proposed. A protection system will also be installed to avoid track contamination by sand. This project has been drawn up entirely by Ineco (see diagram above).
OHL, COPASA and IMATHIA are the partners responsible for track assembly (rail welding, supplying and laying the ballast, slab tracks, etc.), as well as the construction of workshops, depots, technical buildings, assembly bases and maintenance centres. Five assembly bases are planned, two at both ends of the line and the rest at different points along the route. Once construction is completed, the line will have three permanent maintenance bases: two near both ends and a third at kilometre point 125.

An 'AVE' for the desert

The route runs north to south, parallel to the coast for several kilometres, with incoming winds from the Red Sea producing two main effects: the presence of sand clouds and the formation and movement of dunes. When it enters the ballast, sand affects all of its functions: it reduces track elasticity and stress distribution on the platform, erodes it and prevents track drainage, one of its most important functions. Rainfall can be brief, but very intense. On the 444-kilometre line, the points where these effects may occur have been located and specific solutions have been proposed for both design and maintenance, which are closely linked. The design includes specific sand collection areas, protection walls for controlling sand accumulation and the installation of slab tracks on those sections most affected by sand clouds. Thus, the design is intended to facilitate maintenance tasks, and to draw up a plan to protect the superstructure from invasion and contamination by particles.

*** Track maintenance will take place mostly at night. The bases and equipment will be strategically located to facilitate access to the route. Rolling stock maintenance is also essential. Different levels have been established, to be performed at different times: light maintenance will occur at night or at off-peak times, while heavy maintenance will require taking the units out of service for a few days.**

All elements of the project are being adapted to the high traffic intensity predicted by the promoters (around 160,000 passengers daily).

➔

STATE-OF-THE-ART TECHNOLOGY. There will be two Operation and Control Centres: the main one (located in Jeddah) and a backup centre.

The Haramain represents a historic milestone for OHL. The company is already present in the region thanks to the Ankara–Istanbul high-speed project in Turkey, in addition to the Marmaray Project connecting the railway lines between Europe and Asia. "This emblematic project represents the best opportunity for consolidating the group's presence in Saudi Arabia. This makes OHL a leading contractor for this type of major railway projects, which will be undertaken in the future in countries such as Brazil, the UAE and the US."

A spokesman from COPASA emphasises what a "great honour" it is to belong to the consortium that brings together the best Spanish high-speed rail companies. "Being awarded this contract, while competing with several consortia from all over the world, is a decisive step in the export and recognition of Spain's high-speed rail expertise, and is a good example of the high technological level that the Spanish administration and companies have achieved in this field."

IMATHIA, present from the beginning of the project, celebrates "a great triumph" after "five long years of gestation, while maintaining our enthusiasm and confidence." The company's management highlighted that building the superstructure and assembly bases, along with 12 years of maintenance and conservation, "represents a challenge" that IMATHIA is sure to successfully complete. "Participation in this consortium enables us to develop as an international railway company," they explained.

>SIGNALLING AND TRAIN PROTECTION

Dimetronic

Dimetronic will supply its railway signalling and control technology, including its advanced Level 2 ERTMS train protection systems, FUTUR 3000 and FUTUR 2500, its RAIL 9000 Centralised Traffic Control (CTC) system integrated in the Operation and Control Centre, track equipment (LED signals, needle drives and train detection equipment) and WESTRACE electronic interlocks, which establish itineraries for safe train movements by controlling track apparatus and signalling. Jesús Guzmán, CEO of Invensys Rail Dimetronic Southern Europe, is proud to belong to "this great team," which enables

Although all the stations have a common architecture, each one has decorative elements differentiated by colours.

➔

his company to export its high technological profile and expertise in railway signalling and control, "with a clear, customer-focused orientation." Dimetronic is already present in the region with projects in Turkey, including the emblematic Marmaray Project, which it was recently awarded. "But the Haramain is a special case on the international railway scene," said Guzmán.

>CONTROL SYSTEMS, SECURITY AND TELECOMMUNICATIONS

Indra

As Regino Moranchel, executive vice chairman of Indra, explains: "This project consolidates Indra's position in the Middle East, and shows a clear commitment to the railway industry and the development of internationally tested, state-of-the-art domestic technologies in countries such as the UK, China and the US."

Indra will implement the following systems:

>**Telecommunications network** with IP technology (fibre optics), integration of voice, data, ticketing and passenger information together in a single network.

>**Operation and Control Centres.** There will be two: the main one (located in Jeddah) and a backup centre. Both will be equipped with the Da Vinci comprehensive railway platform, developed by Indra and implemented by Adif on all Spanish high-speed rail lines.

>**GSM-R** (digital radio telephony) fixed and mobile communications for voice and data.

>**On-board Wi-Fi Internet** with satellite technology.

>**Ticketing.** Issuing systems and equipment, automatic and manual sales points, electronic payment systems, ticket cancelling machines, access control doors and machinery, tickets using contactless technologies.

>**Simulators.** The Spanish company has developed a comprehensive training system for high-speed train drivers and other personnel based on an ideal simulation environment, making it possible to test new functionalities under real conditions. The environment is comprised of a combination of different types of simulators, depending on the type of railway personnel to be trained.

>**Closed-circuit television (CCTV),** with IP digital technology and installation surveillance and security systems.

THE STATIONS

The first phase of the project included the architectural design and construction of the five stations on the line, awarded to the joint venture comprised of the British companies Foster+Partners and Buro Happold, along with the Saudi firm Dar Al Riyadh.

Although all the stations have a common architecture, each one has decorative elements differentiated by colours: gold for the Makkah station (in reference to the gold adorning the sacred stone of the Kaaba), green for the Madinah station (the colour of the dome of the Great Mosque housing Muhammad's tomb), purple for Jeddah Central Station, and a more futuristic combination of blue and silver for KAEC, as a symbol of modernity. All of them feature large spaces and an arch structure grouped into 'trees' 25 metres high, supporting a flexible modular roof. These are complemented by smaller ones measuring 9 metres on the platform level.

The Saudi Railways Organisation expects to begin serving passengers in late 2014 or early 2015.

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>Passenger information systems. Electronic panels and signage at stations and on trains, information via the web or SMS, public address system, etc.
>Maintenance management system. Modular and adaptable, integrating all elements and systems on the line in a single solution: infrastructure, telecommunications, signalling and interlocks, stations and buildings.

>ELECTRICAL POWER SUPPLY
Cobra, Inabensa and OHL

>Supply and installation of high-voltage equipment (electrical substations). Electric traction substations, auto-transformation centres with a voltage of 25 kV at 60 Hz. "For Inabensa –according to Alfonso González, the company's president–, participation in this project is of great strategic importance because it allows us to consolidate our activities in Arabia Saudi and the Middle East, where we have had a stable presence for over five years and our sales have experienced high growth over the past three. It also helps us to establish ourselves as leaders in the area while simultaneously strengthening our subsidiaries with a new activity."
>Catenary supply and installation. The C350 catenary was developed by Cobra, along with other companies. On the Haramain project, over 18,000 suspension elements and a total of 450 kilometres of double track will be implemented. According to Miguel Ángel Martínez, CEO of Cobra Ferrocarriles, this represents "an important challenge that will bring even greater recognition for Spain's contribution to high-speed railway development." He also emphasised that from the very beginning, more than five years ago, he knew the project would be successful. Finally, Martínez added that Cobra's participation "consolidates" the company's leadership in the industry.
>Supply and installation of medium- and low-voltage equipment (exclusively by Cobra) to power signalling equipment, train protection systems, telecommunications, Centralised Traffic Control (CTC) and domestic installation. Cobra will also provide protection from overvoltages and electrical disturbances, will supply and construct all detection systems, and will install the signalling cables.

EXCLUSIVELY DESIGNED TRAINS
The tendering conditions specify that the trains must be designed exclusively for the line. The pictures in this page (above and top) show proposals by Talgo.

OPERATION STAGE

>COMPREHENSIVE MAINTENANCE [12 years]
Adif and Renfe

An essential part of the contract is the comprehensive maintenance of the line. For the rolling stock, the tendering conditions establish that this must begin during the construction stage. For the installations, it will begin when starting the commercial service, taking into account the respective warranty periods: three years for the infrastructures (to be built by Al Rajhi Alliance with French, Chinese and Saudi participation) and two years for the stations. This work will require comprehensive management and technical control support, in which Ineco will assist Adif and Renfe.

>OPERATION MANAGEMENT [12 years]
Adif and Renfe

The SRO expects to begin serving passengers in late 2014 or early 2015. Renfe Operadora is in charge of commissioning and commercial operation of the trains, as well as Adif is for traffic management and operation of stations, with the same standards and quality commitment applied to Spain's high-speed rail lines. The companies will undertake this task once construction is completed and will be responsible for developing the corresponding Economic, Operation and Safety Plans.

>CONSULTANCY
Ineco and Consultrans

During the operation phase, both will also support the consortium by conducting demand, economic-financial, market, rate policy, service quality and other studies.

The bases for a major project

Track assembly works on the Levante corridor

Published in itransporte 30

They are the nerve centres for track assembly: assembly bases are basically used to centralise, organise and distribute materials and machinery. Although some are destined to be temporary, others are kept as maintenance bases.

The first phase of the new high-speed rail corridor between central Spain and the Levante coast began serving the cities of Valencia and Albacete in December 2010.

Ineco participated in different aspects of this major project (see itransporte English Edition, Issue 2), such as track assembly, which included technological and geometric definition, management of material cycles and track apparatus, management of train movements during the works, project execution control, and final acceptance. These tasks included the design and placement of the assembly bases.

During the assembly phase, the bases become the nerve centre for the works: strategically located along the route, they serve as material storage sites and operate as logistical centres from which the works are organised. Five new facilities were built as part of the Madrid–Albacete–Valencia section of the corridor, which began construction in 2008: Villarrubia de Santiago (Toledo), Gabaldón (Cuenca), Requena and Almussafes (both in Valencia) and Albacete. The Manchegan city was the first to be built, in late 2007. The base in Monforte del Cid (Alicante) was added later to support the construction of the Albacete–Alicante section. The existing Madrid Sur base was also used during the project.

An assembly base must include a maintenance shed equipped with a pit for machinery and a crane.

The Monforte del Cid (Alicante) base, which covers 6 hectares.

The Villarrubia de Santiago (Toledo) base. Maintenance bases require large surface areas (around 10 hectares) for storing large materials.

Ineco participated in the construction of four of these bases by providing technical assistance, and performed site management for another two. The distribution and specific locations for the bases were planned to serve assembly sections 40 to 100 kilometres long. Ineco had already acquired experience on other high-speed lines, such as the Madrid–Valladolid and Madrid–Barcelona lines.

These facilities can be temporary or permanent. Temporary bases are used during the works to store and manage materials and provide logistical support. Permanent bases are later known as "maintenance bases" and remain operational after the line starts service. On the Levante line, Villarubia, Requena and Monforte del Cid are now maintenance bases. Thus, depending on their long-term purpose, the minimum requirements for each base are established in terms of surface area, location, equipment, etc.

Because their initial purpose is to store materials, and considering that the long workshop rods and metal parts of high-speed apparatus must be transported by train, there must be at least one base connected to an operational line every 100 kilometres. A base should have 10 hectares of surface area located as close as possible to service connection points.

The assembly bases are connected to the new high-speed line and, in some cases, to an operational line that makes it possible to access the rails, ballast and track apparatus by train. In every case, their structure and design provide a material sorting and distribution service, and allow for the organisation and maintenance of railway vehicles and track machinery. *

Facilities at a high-speed line base

>MINIMUM

- Connection to a high-speed line.
- Connection to the road network. Must be designed to allow access by special transport vehicles (rail cars and locomotives).
- Track yard with a maximum gradient of 0.25%, except on access roads, which are limited to 1.2%. Minimum radii are established for manoeuvres with large loads (C turns tg 0.09).
- Maintenance shed equipped with pit and 5 ton crane (1,000 m²)*.
- Surface area for material storage: sleepers, ballast, coils, etc.
- Ballast loader (min. wall: 150 metres long and 1.5 m high from rail head height).
- Installations for electrical power, water and sanitation connections.
- Fire protection network.

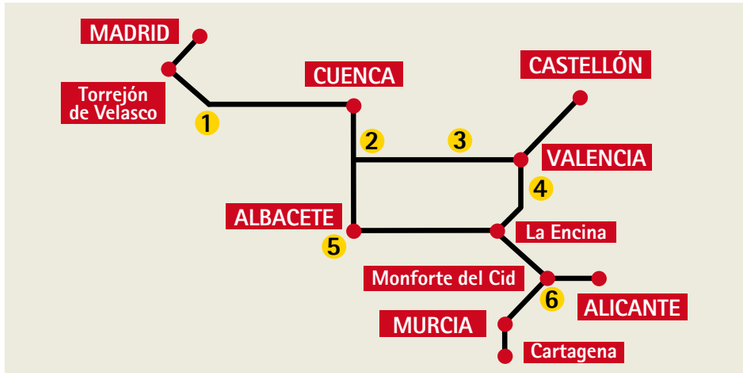
>TEMPORARY

- Connection to the operational line.
- Slab and gantry for rail transfer and storage (14 units distributed over 280 metres, approximately).
- Slab and double gantry for storage and pre-assembly of track apparatus (load capacity: 2x12.5 tons).
- Truck scale.
- Ballast unloader (optional).
- Axle interchanger (optional).

>PERMANENT

- Warehouse (400–2,500 m²)*.
- Office building (850 m²)*.
- Fuel supply facility.

*Data for guidance only (may vary depending on land availability and the expected functionality).



Madrid–Levante corridor

To the left is an schematic map of the new Levante high-speed corridor, which shows the location of the different assembly bases:

1. Villarrubia de Santiago, Toledo (maintenance base).
2. Gabaldón, Cuenca.
3. Requena, Valencia (maintenance base).
4. Almussafes, Valencia.
5. Albacete.
6. Monforte del Cid, Alicante (maintenance base).

Always at the ready

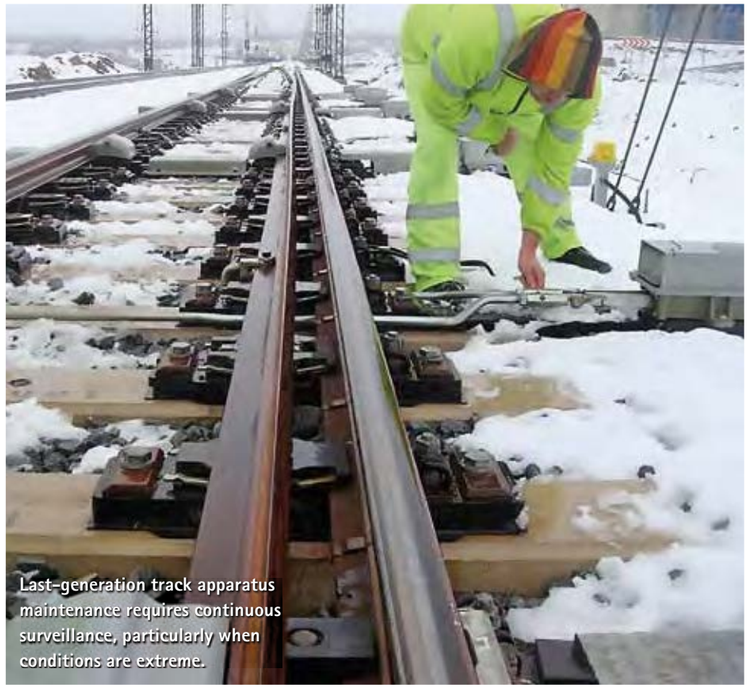
Track maintenance

Published in itransporte 39

Ineco exclusively controls maintenance of the infrastructure, superstructure and facilities on Spain's entire high-speed network.

Ineco has acquired extensive know-how in the area of high-speed railway line maintenance since 1992, when Spain's first AVE (high-speed) line began operating. The company has specialists in every technique: tracks, infrastructure, power, communications and signalling. Work is organised from maintenance bases distributed along the lines, every 150 or 175 kilometres. There are 13 operational bases located throughout the country, coordinated by a central team placed in Madrid.

The maintenance model, known as "condition-based maintenance", is based on continuous surveillance and preventive action on all subsystems. This prolongs the useful life of the railway infrastructure and guarantees safe train movements, infrastructure availability, railway operation regularity and customer comfort. ✱



Last-generation track apparatus maintenance requires continuous surveillance, particularly when conditions are extreme.

Basic conditions of condition-based maintenance

- **Thorough knowledge of the infrastructure, platform, track and facilities.**
- **Definition of the status parameters for all subsystems and quality standards according to the operating conditions.**
- **Controlling the quality of systems.**
- **Analysis and diagnosis of the causes of any defects that arise.**
- **Systematic, orderly use of the available maintenance resources in order to optimise conservation costs and times.**

Ineco's tasks

- **Continuous inspections of elements.**
- **Planning, control and supervision of maintenance tasks.**
- **Analysis and study of all dynamic and geometric auscultations of tracks and catenaries, etc.**
- **Monitoring elements.**
- **Supervision and control of third-party projects that could affect the line.**
- **Planning, control and supervision of cyclical maintenance.**
- **Incident response 24 hours a day, 365 days a year.**

LOCATED THROUGHOUT SPAIN

The 13 maintenance bases are distributed along Spain's different operational high-speed lines, in the following cities: Sant Feliu de Buixalleu (Girona), Vilafranca del Penedès (Barcelona), Lleida, Calatayud (Zaragoza), Brihuega (Guadalajara), Olmedo (Valladolid), Villarubia de Santiago and Mora (Toledo), Gabaldón (Cuenca), Requena (Valencia), Argamasilla de Calatrava (Ciudad Real), Hornachuelos (Córdoba) and Bobadilla (Málaga).

Albacete: nerve centre

New CRC for the Madrid–Levante corridor

Published in itransporte 35

The Manchegan city hosts the facility that controls all operations required for train movements on the AVE corridor to Levante. It joined the centres in Zaragoza, Segovia and Antequera, which are already operational. Ineco is providing technical assistance for this new project.

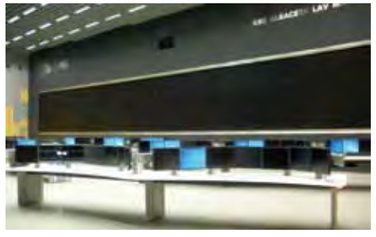
Since it was first implemented in Zaragoza on the Madrid–Lleida high-speed line, the Control and Regulation Centre (CRC) concept for railway control and management centres has been extended to other Spanish high-speed lines, replacing the old command post concept.

The new CRC in Albacete will initially control 433 kilometres on the Madrid–Valencia and Motilla–Albacete sections. It will later cover the scheduled expansions, eventually controlling all 940 kilometres of the future high-speed line that will link Madrid to Castilla-La Mancha, the Valencian Community and Region of Murcia.

Functionally, the Albacete CRC will be responsible for directing and coordinating train movements in real time, following an operation plan drawn up at the request of the railway companies. Safety and service quality will be its primary objectives.

The CRC will contain the traffic control and management systems and associated elements (remote signalling control, remote power control, ERTMS command centre, remote detector control, communications integration, etc.) It will also house the DaVinci platform, which integrates all of these elements in a real-time environment, making it the nerve centre for the corridor. ✱

The new CRC right before its opening in December 2010.



The DaVinci platform

This is one of the most advanced railway traffic management systems in the world. DaVinci is an integration platform for railway control and management systems. This tool is owned by Adif (Spain's railway infrastructures administrator) and has been implemented by the Spanish technological company Indra, based on the functional and technical requirements generated.

Ineco has worked closely on this project since it began in 2002. Its function is to standardise and implement the exchange protocols and computer and communications architectures needed for the different control and management systems to interact and share information, thus facilitating the work of the different remote control operators.

It was designed for high-speed rail, but can be adapted to other types of railway traffic on conventional lines, narrow gauge lines, and even metros and trams. The DaVinci platform is being exported to other countries, clearly indicating that the comprehensive management of processes, systems and users marks the design trend for such centres in the future.

AVE, Madrid salutes you

A tunnel will connect the Spanish high-speed lines from the north, south and east

Published in itransporte 40

In spite of the magnitude of the project in which Ineco has participated, the excavation of the new high-speed rail tunnel was completed ahead of schedule, with no significant incidents or environmental repercussions.

It starts at Chamartín train station, runs under Madrid's commercial *Golden Mile*, passes under its most popular monument (Puerta de Alcalá) and crosses the subsoil of the Botanical Gardens to emerge in Atocha train station, epicentre of Spain's rail network.

On the way, it crosses nine Metro lines and two commuter rail lines (Cercanías), and passes through clayey ground. An enormous tunnel boring machine –the most effective excavation method for this type of land– was therefore used along most of the route. It is also the deepest of the three railway tunnels crossing the heart of Madrid: at 46 metres, it digs at the depth equivalent to a 15-storey building.

Excavation was completed in February 2011, ahead of schedule, without incidents or environmental repercussions for the buildings on the surface. This represents a technical success for Adif (promoter of the project), the companies in charge of construction (a joint venture between Dragados, FCC, Constructora Pirenaica and Tecsa), the firm providing technical assistance (TYPSA), and the company solely responsible for site and environmental management: Ineco.

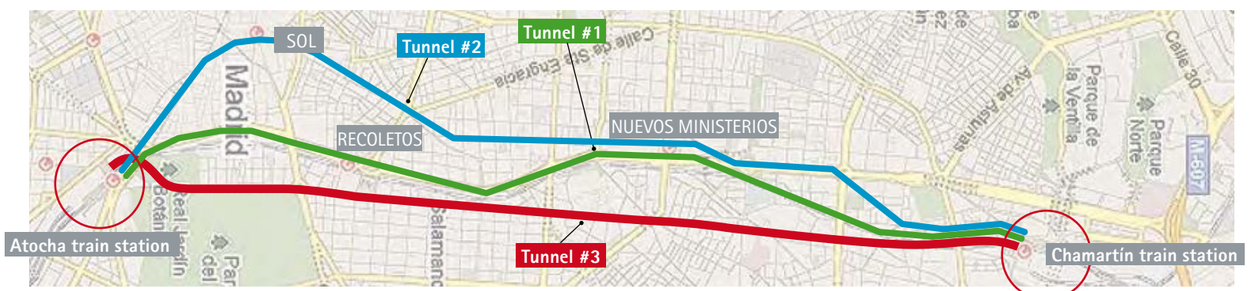
Once the construction is complete, work will continue in 2012: part of the cross-section of the tunnel has already been filled in before reaching the definitive depth, and the tracks and safety protection installations will be put in place. For these tasks, Ineco will provide technical assistance to the management team. Later, the electrification, signalling and telecommunications systems will be installed. ✱

BENEFITS OF THE NEW TUNNEL

When this tunnel opens, the high-speed lines from the north, which arrive and depart from Chamartín, and those from southern, northeastern and eastern Spain, which operate through Atocha, will be interconnected on the network. In addition to improving Spain's territorial 'permeability', the tunnel will increase the country's railway capacity. The Spanish Ministry of Development predicts that 35 million AVE passengers will pass through Madrid in 2020.

TECHNICAL CHARACTERISTICS

TOTAL TUNNEL LENGTH	**7,300 m**
EXCAVATION DIAMETER	**11,495 mm**
INSIDE DIAMETER	**10,400 mm**
CONSTRUCTION METHOD	EPB tunnel boring machine
TRACK TYPE	Double slab track with *International* (UIC) gauge
NUMBER OF EMERGENCY EXITS	**9**
NUMBER OF PUMPING SHAFTS	**4**
NUMBER OF VENTILATION SHAFTS	**3**
MAXIMUM PROJECT SPEED	**120 kph**



The route (a total distance of 7.3 kilometres)

The route begins at the southern end of the Chamartín train station. It runs below constructed areas before reaching República Argentina. It then remains centred under Serrano and Alfonso XII streets, to end up at Plaza del Emperador Carlos V (Atocha train station).

EXCAVATION AND CLADDING_The boring machine excavates while simultaneously lining the tunnel with rings of reinforced concrete voussoir.

PHOTOS BY PABLO NEUSTADT

Ineco's participation

>ACTIONS AT CHAMARTÍN

The company was responsible for site management and technical assistance for the project, as well as technical assistance for track assembly and preliminary work at the southern end of the Chamartín train station.

>'LISTENING' TO THE TUNNEL

Ineco also provided technical assistance for geotechnics, structures and excavation machinery. Even before excavation began, inspection tasks were performed on nearly 500 buildings: over 1,400 homes and business premises located in the vicinity of the project. Both underground and on the surface, more than 3,500 devices were installed to monitor the ground and the surrounding structures (underground parking garages and Metro and commuter train tunnels), as well as surface structures, including some monumental buildings such as Puerta de Alcalá, Casón del Buen Retiro and the Archaeological Museum.
The data was collected remotely using SIOS, an information system developed entirely by Ineco. This system is also used as a database at the Adif Information Office located at Plaza de Colón. Along with institutional relations, this is another service provided by Ineco for this project.

>SAFETY UNDERGROUND

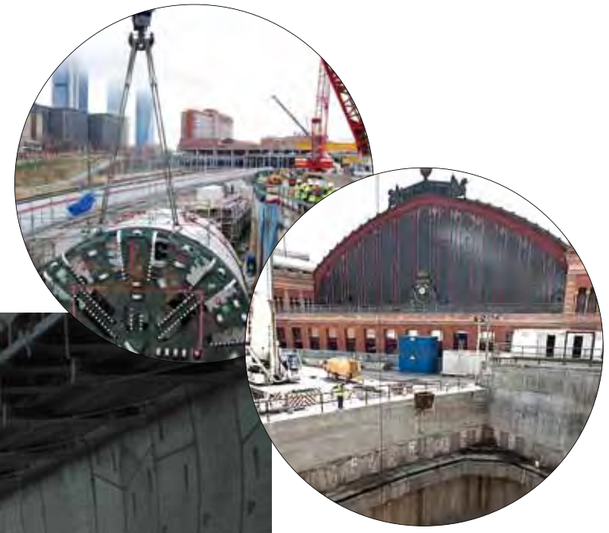
The company was also responsible for preparing the operation manuals for the tunnel (containing the safety specifications), as well as the self-protection plans. The tunnel is equipped with nine emergency exits, three ventilation shafts and four pump shafts.

The new tunnel will be used exclusively for high-speed trains and will be the only one in Madrid equipped with 'International' gauge tracks.

Environmental management

Since late 2008, Ineco has also been responsible for the environmental management of the project and compliance with the environmental surveillance programme established in the corresponding Environmental Impact Assessment (EIA). Although Adif has emphasised that construction of the tunnel caused "little impact" overall, efforts have been made to ensure minimal effects on citizens and the environment. Among these actions, the archaeo-paleontological studies conducted are worthy of mention, although no relevant findings were recorded. Steps were also taken to protect the urban vegetation. With help from the Madrid City Council, 138 trees were transplanted. To avoid problems with noise and atmospheric pollution, quarterly campaigns were also conducted to measure dust, noise and vibrations.

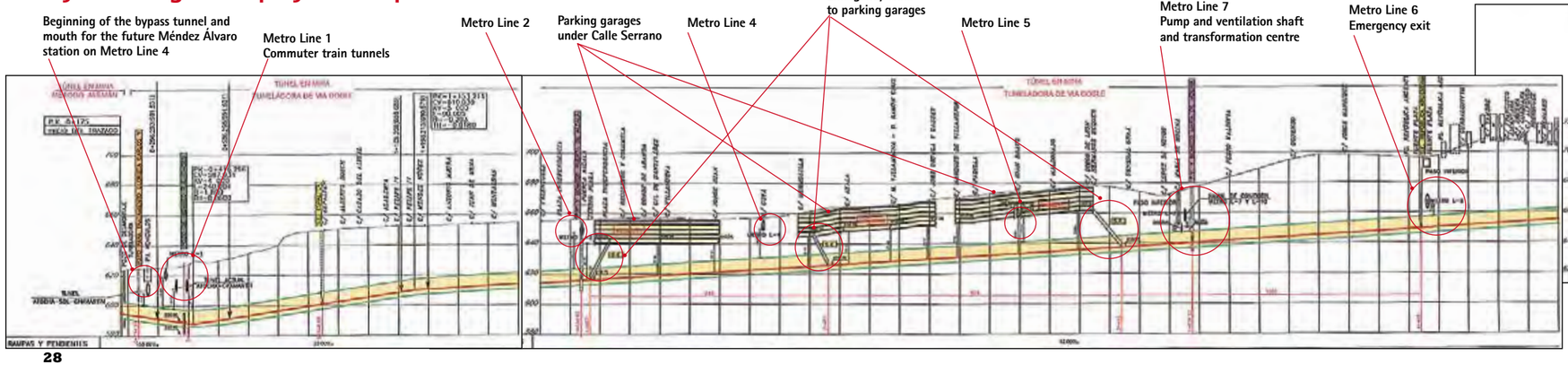
TBM DISMANTLING SHAFT at Atocha (right). Until the tunnel was completed, the only access point for materials was at Chamartín.



Madrid's third major tunnel

Madrid had until now two rail connections between the Atocha and Chamartín stations (see graph in page 26), both with *Iberian* gauge tracks (1,668 mm): the Recoletos tunnel (1967) and the Puerta del Sol tunnel (2008). Both serve trains on the commuter, medium-distance and long-distance networks. The new tunnel will be used exclusively for high-speed trains and will be the only one equipped with *International* gauge tracks (1,435 mm). Its construction complements other major projects, such as the expansion of the Atocha station and the branch line that will make the high-speed lines to the Levante and Andalusia independent.

A major underground project completed in record time



Antioquia sees the return of the train

Ineco participates in two major projects to renovate historic railways

Published in itransporte 39

Colombia will regain a historical railway infrastructure for transporting passengers and urban waste, in a region with extremely rugged terrain. Ineco has concluded the initial technical and economic viability studies for the project.

Medellín, capital of the Department of Antioquia, is home to 12% of Colombia's population. Economically, it is the country's second most important city. Medellín's extensive metropolitan area is comprised of 10 municipalities and has a total of 3.3 million inhabitants distributed over the narrow Aburrá Valley, located in the middle of one of the world's most mountainous regions.

The "Antioquia Railway" was inaugurated in 1929, linking the municipalities of Caldas (south of Medellín) and Santo Domingo (north of the city). This line handled cargo until 1999 and served passengers until the year 2000.

In 2007, the Colombian government authorised the renovation of this historic railway line, in addition to two others: the Cauca Valley line and the old "Bogotá Savannah Railway" (also with participation from Ineco), both of which are commuter lines. The Antioquia line was then renamed the "Aburrá Valley Multipurpose Railway System".

The objective is to restore roughly 80 kilometres of the old route and adapt it for mixed use (passengers and cargo), and specifically to use the line to transport waste from the city of Medellín to the landfill at La Pradera Environmental Park, located about 43 kilometres from the city.

In 2009, the organisations promoting the project (the Colombian Ministry of Transport, the government of Antioquia, the Office of the Mayor of Medellín, the Institute for the Development of Antioquia, the Metropolitan Area and Metro de Medellín) chose Ineco to draw up the "technical, legal and financial structure" for the line. In November 2010, the Project Management Committee agreed on the guidelines for the continued development of the project. The aim was to make the northern section of the line operational in the short term. *


'LA PRADERA' STATION
Both 'La Pradera' station and the track will be renovated and adapted to accommodate the receipt and dispatch of all of the city's solid waste. This is an efficient alternative to road transport for large quantities of waste.

Ineco in Colombia

Ineco is also participating in another Colombian government project to renovate historic railways. It focuses on the 'Bogotá Savannah Railway' and will utilise the existing route for future commuter lines. In 2010 and 2011, Ineco reviewed the technical and operational structure of the commuter rail system in the western corridor (an 86.4-kilometre network), as well as the studies and designs for the stations. These studies were commissioned by the Project Development Fund for Cundinamarca, the department where Bogotá is located.

The project

Ineco's tasks includes the analysis of the railway route as well as the type of rolling stock to be used for both passengers and solid waste. It also covers the architecture of the passenger stations, the location and sizing of a waste transfer station, as well as all systems, equipment and installations needed to operate the line: the workshops and their equipment, the rail yard and the parking areas.

The route is approximately 80 kilometres long, of which 20 kilometres run through urban areas of Medellín, parallel to Line A of the Medellín metro network. The tender requirements called for a comparative analysis of the implementation of a single track with different gauges (914 mm, 1,000 mm and 1,435 mm) or a double track: in this case, multipurpose sleepers would be used, capable of housing an additional third rail. Colombia's national gauge, 914 mm, would then be able to coexist with the new 1,435 mm track. The train will run at a maximum speed of 100 kph. From a passenger service perspective, because the line is intended to link the areas north and south of the city, transfer stations have been planned along the route to provide access to the metro and other systems on the Medellín transport network.

For cargo service, the line will initially be used for the transport of solid waste generated in the Aburrá Valley, given the lack of connection to the national railway network to the north and south required for bringing general cargo out of the valley. The characteristics of this type of cargo require an analysis of the specific rolling stock most suitable for carrying it, as well as the location and sizing of a transfer station.

The organisations promoting the project chose Ineco in 2009 to draw up the 'technical, legal and financial structure' for the line.

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Renovation of the route

A new route is required due to the current urban distribution of the municipalities bordering the existing corridor in the southern Aburrá Valley. This circumstance, coupled with the steep slopes of the local terrain, the narrowness of the valley and the numerous gullies and ravines along the Medellín River, means that new detailed engineering studies must be conducted along the route in order to reach the cargo station associated with the 'Primavera' Logistics Centre in Caldas.

As far as the section crossing Medellín is concerned, the route is conditioned by spatial limitations and other issues typical of the integration of such routes in urban areas, and by the need to coordinate the railway works with road infrastructure projects on the banks of the river. One of these is the so-called "river road concession": 24 kilometres of roadway with multiple lanes on both sides of the riverbed, which will channel the city traffic. To circumvent both conditioning factors, the study proposes dividing the project into phases. During the first one, the northern section will be renovated, between the stations of 'Bello' and 'Botero' in Santo Domingo. In the middle term, the central and southern sections will follow.

Economic viability

Regarding the necessary investment, the Ineco study indicates that it will be equivalent to €106 million if the northern section is used to transport passengers and waste, and €58 million if used only for waste.

It is worth noting that, according to the different economic, financial and operational scenarios considered, the analysis indicates that the tons of solid waste that would potentially be transported would generate sufficient revenue to make the line economically viable, in addition to ensuring optimum cash flows for the operating company (reinvestments in rolling stock and infrastructure expansion), as long as the initial investment is subsidised by the Colombian government.

Railway sidings and workshops in Bello.

Caldas station.

Route in Girardota.

LOCATION OF THE TRANSFER STATION

Different locations within the Department of Antioquia were analysed for the transfer station, from which waste would be transported by rail to 'La Pradera' Environmental Park, located on the border between the municipalities of Barbosa and Donmatías, approximately 43 kilometres from Medellín.

'La Pradera' began operating in the year 2003 and it now receives roughly 1,800 tonnes of solid waste daily from over 10 municipalities, according to data provided by the local company Empresas Varias de Medellín, which is responsible for the service. Finally, the new location chosen for the transfer station is a lot in the area bordering the Caribe neighborhood (south of the municipality of Bello), where the social and environmental impact would be lower.

A 'made in Spain' metro for Medellín

Ineco supervises the construction and commissioning of 13 new trains

Published in itransporte 41

Metro de Medellín is updating its fleet with Spanish technology. Ineco is in charge of supervising the entire process of development, manufacturing and fine-tuning the new trains produced by CAF.

Metro de Medellín is updating its rolling stock with 13 new three-car trains manufactured in Spain by the Basque firm CAF, to be added to its current fleet of 42 trains. Ineco is responsible for supervision and technical management for the entire design, construction and commissioning project at the CAF factories in Spain (Zaragoza, Beasain and Irún) and in Colombia, where track tests are being performed. Metro de Medellín expects to complete the commissioning process for all units during the first half of 2012.

The first conventional subway line in Medellín (Line A) began operating in 1995. Due to its rugged terrain, which covers a mountainous area 1,300 metres above sea level, Medellín became in 2004 the first city in the world to use cable cars for mass transit.

The Medellín metro network transported roughly 159 million passengers in 2010, 7% more than in 2009, according to figures from Metro de Medellín. It has *International* (UIC) gauge tracks and 32 stations, of which 25 serve conventional subway trains and the rest are Metrocable cable car stations.

Line A runs from north to south for 23.2 kilometres and has 19 stations. Line B is 5.6 kilometres long and runs west from the centre, with a total of 6 stations. The Metrocable has 7 stations: 3 on Line K (2 kilometres long and located to the northwest), 3 more on Line J (2.9 kilometres west) and 1 on Line L, or "Cable Arví", a tourist line 4.6 kilometres long. ✱

Ineco's task

Ineco's teams are working closely with professionals from Metro de Medellín.

DESIGN SUPERVISION_First, a follow-up study is conducted to ensure that the project meets the contractual requirements. The functional and technical specifications, calculations, drawings and protocols are also reviewed, with special attention to the safety and reliability conditions of all elements.

INSPECTION_Ineco personnel is present at the type and routine tests performed on the main equipment at source, in laboratories or at the supplier's facilities. They also perform inspection tasks during production and during type and routine tests at the factory. Once all units are tested, the cars are uncoupled for transport on large platform trucks to the port. They first arrive to Cartagena de Indias and finally reach the appropriate Metro de Medellín premises after travelling some 8,700 kilometres by sea and road.

COMMISSIONING_Once in Medellín, the Ineco team sent to Colombia supervises the type and routine tests on the track and the fine-tuning of the units so that they can progressively begin operation.

A rail thermometer

Implementation of thermographic inspection on overhead contact lines

Published in itransporte 34

Ineco and Adif began in 2008 a pilot project to implement thermographic supervision on overhead contact line installations on Madrid's commuter train network (Cercanías). The results obtained were so good that they extended the project to include the electrical traction substations on the conventional network.

Thermographic inspection makes it possible to check the condition of parts where temperature increases can occur without having to stop operations. It detects hot spots, which is useful for diagnosing and preventing operational failures. This increases the reliability and availability of the installations by facilitating the work of maintenance teams.

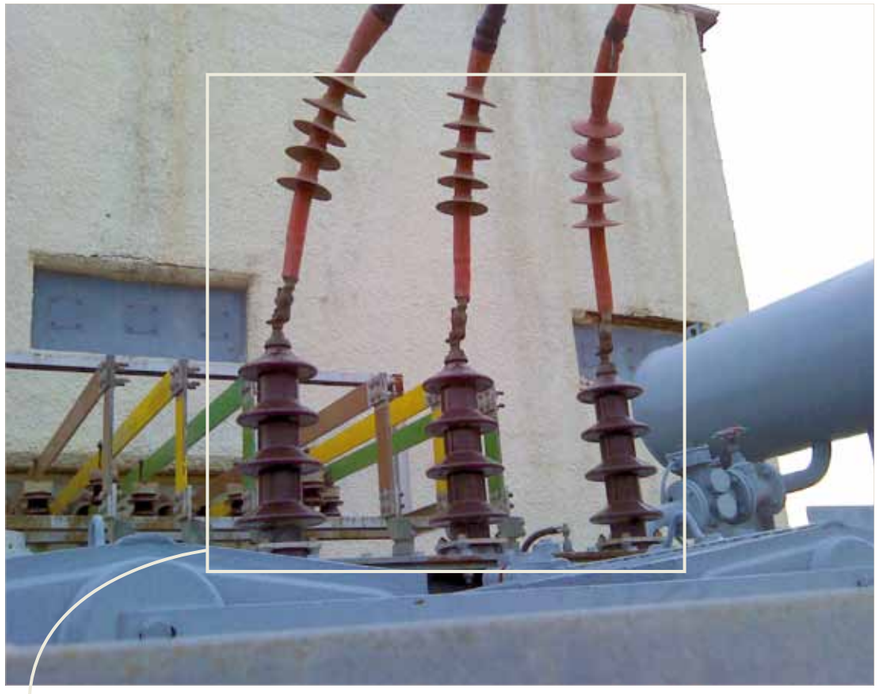
Despite the fact that this technique has been used for a relatively short time, the number of hot spots detected and repaired since the pilot project started has been significant, thereby preventing more serious consequences and failures with high economic costs. Its usefulness for anticipating problems and as an effective tool for any kind of preventive maintenance has been fully justified.

Although thermography is a technique widely used in electrical installations, its application to electrification installations, in both overhead contact lines and traction substations, required thorough study and specific analysis due to its unique characteristics.

Thermography can basically be defined as the graphic recording of the heat emitted by an object's surface in the form of infrared radiation. The Stefan-Boltzmann law establishes that all objects at temperatures over absolute zero (-273.15 degrees centigrade) emit energy in the form of electromagnetic waves. This means that all objects emit energy in the form of electromagnetic radiation and tend to seek thermal balance with the objects surrounding them.

Images of thermal radiation. Thermographic cameras are equipped with a germanium lens and a microbolometer measuring system that enables them to capture images of the infrared radiation emitted by objects. Such cameras are used to obtain a thermogram: a representation of the differences in the radiation emitted by objects, shown in a palette of colours. If the emissivity is known, this can be used to calculate the temperature. Another parameter that plays a role in thermography is the reflected ambient temperature. Along with the emissivity, it helps finding the radiation of the object to be measured by subtracting the reflected radiation.

Based on the theoretical foundation for the technique and the operation and characteristics of the thermographic cameras, the parameters to be considered for the proper creation of a thermographic image are the emissivity of the object to be inspected, the reflected ambient temperature, temperature range, thermal focus, image composition and the instantaneous field of view measured in relation to the distance at which the image is being taken. On some occasions, when observing an object with very low emissivity or in high humidity conditions, it can be truly difficult, or even impossible, to obtain an accurate temperature reading. ✱



Types of analysis

There are two types of thermographic analysis: qualitative and quantitative. Qualitative techniques involve detecting temperature gradients in the objects under inspection. Any defects in the installation causing the temperature gradient can be located by comparing them to other objects of the same type. One of the advantages of this technique is that it does not require an accurate temperature measurement. The factors just described have therefore less impact on the result of the inspection than they would if quantitative thermography were used.

On the other hand, quantitative techniques are based on obtaining an accurate temperature measurement in order to perform an assessment of the potential problems detected. Correct use of this technique in thermographic inspections of overhead contact lines would be exceptional because it would require scenarios in which none of the restrictions mentioned were found, as their impact on the result of the inspection is very high. For the reasons explained above, qualitative thermographic analysis were performed in most cases.

Capturing radiation images

Monitoring with thermographic cameras has reduced inspection times, and made inspections safer and less costly. In addition, diagnoses can be performed without interrupting operations.

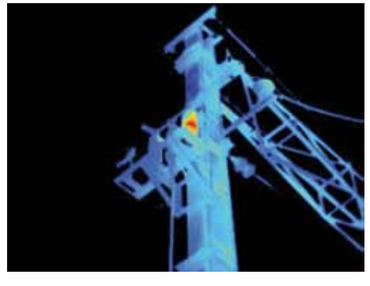
The Stefan-Boltzmann law, which states that all bodies at temperatures over -273.15ºC emit energy in the form of electromagnetic waves, coincides with the equation $P = \varepsilon.\sigma.T^4$.

P = power emitted.

ε = emissivity of the body.

σ = Stefan-Boltzmann constant.

T = absolute temperature of the body.



NON-CONTACT TECHNIQUE. **Thanks to thermography, it is possible to easily and accurately measure the temperature of objects without interfering with their operation, as these techniques require no contact. The images above show the S phase element of a transformer in an electrical substation.**

INSPECTIONS

>ELEMENTS SUBJECT TO THERMOGRAPHIC INSPECTION ON THE OVERHEAD CONTACT LINE	>ELEMENTS SUBJECT TO THERMOGRAPHIC INSPECTION AT SUBSTATIONS	>OTHER ELEMENTS REQUIRING INSPECTION
■ Substation output ports	■ Arrival of the line	■ Power supply for traffic signal line
■ Supply feeders	■ Power measurement and control equipment	■ Negative bar
■ Catenary	■ Connection to mobile substation	■ Power and lighting panel
■ Return feeders	■ Traction unit	■ Protection equipment 3.3 kV
■ Other elements	■ Feeder outlets	■ Control cabinets
	■ Substation auxiliary services	

Guaranteeing railway security

Ineco became an Independent Safety Assessor in 2009

CENELEC standards

Published in itransporte 40

The Spanish Ministry of Development has broadened the authorisation granted to Ineco's Material and Technology Office so that it can act as an Independent Safety Assessor for railway rolling stock subsystems and infrastructure.

In 2009, Spain's National Railway Authority recognised Ineco as an Independent Safety Assessor, with the corresponding duties established by Circular Resolution 10/2008. The recent broadening of this authorisation acknowledges Ineco's quality and experience in this area.

A Safety Assessment is a process of analysis intended to reach conclusions, based on evidence, regarding the conformity of a system, subsystem or component with the assigned safety requirements. To this end, the European Committee for Electrotechnical Standardisation (CENELEC) has developed a series of technical standards to regulate the methodology and determine the processes that must be followed during the conception, design, manufacture, validation and commissioning of signalling and control systems to ensure safe operation.

These standards establish the roles of the agents participating in the projects, particularly that of the Independent Safety Assessor, and indicate the need to monitor the rules to be applied and the processes to be followed. This constitutes a continuous, detailed analysis, not only of the documentation obtained at the end of the process, but of the documents generated during each phase of the life cycle.

The series of CENELEC standards (50126, 50128, 50129) is the point of reference for the evaluation and establishes the bases for the analysis. However, knowing these standards is not enough to successfully complete an Independent Safety Assessment. Such an analysis is not possible based solely on knowledge of the standards. Extensive experience in railway engineering is also a must, including railway installations, rolling stock and safety equipment.

The Safety Department at Ineco's Material and Technology Office meets all of these requirements. This overall system view is what enables Ineco to carry out Independent Safety Assessments with high quality and a notable degree of technical detail, befitting the delicate matter of guaranteeing the safety of train passengers. ✱

Safety at all levels

Independent Safety Assessments can follow several approaches and have different scopes: from low-level subsystems (such as a card rack) to more complex subsystems (such as an interlock, signal or all safety installations on a high-speed line). The Independent Safety Assessor will verify that they comply with the required safety functions and, in the case of an overall system, will check that they have been correctly implemented in their deployment along the line, from conception to commissioning. Every detail is important for guaranteeing passenger safety.

A steel cube to control it all

New Control and Regulation Centre (CRC) in León

Published in itransporte 39

More than 1,600 kilometres of high-speed rail lines will be controlled by the new CRC, to be located in León. The work that will be performed in this modern facility is essential to the safety and punctuality of the network. Ineco was in charge of this unique architectural project.

Access to the building.

Ineco carried out the construction project for the new building in León that will house the installations for the Control and Regulation Centre (CRC), the Protection and Safety Centre (PSC) and the Centralised Traffic Control Centre (CTC) for conventional lines at León train station. The new building will also accommodate the High-Speed Line Authority.

This infrastructure will control railway traffic in the north and northeastern areas of Spain, and will manage high-speed traffic between Madrid–Valladolid–Palencia–León–Asturias, Olmedo–Zamora–Lubián–Ourense–Santiago and Venta de Baños–Burgos–Vitoria, as well as the future Basque "Y". Thus, all railway control offices will be brought together in the same premises. This will be the first building constructed in the new facilities area covered by León's Regional Railway Complex Development Plan.

The project for integrating high-speed rail in León will specify the definitive railway corridor entering the city, and will include the tunnelling of the future underground railway lines. It will also involve the construction of a definitive station, to be located underground. The provisional station was inaugurated in March 2011, making it possible to proceed with railway integration in the city. ✱

The project

>CLOSED VOLUMEN

The new building will have a maximum height of 26 metres and a total surface area of over 5,700 m². The architectural effect will be that of a closed, self-contained unit. A single material will envelop it and help it be understood as a whole. It will feature openings, shaped like cracks running across the facades, which will detract from the massive, blunt character of the cubic shape. These openings will also provide ventilation and lighting for the common areas on each floor. From the outside, they will produce a visual effect in which the cracks of light will play a central role.

THIS EYE-CATCHING ventilated facade will be built using a half-foot brick wall, lined on the inside with plasterboard and anchored to hidden galvanised steel framing. It will be equipped with water-repellent mineral wool and ventilated chamber exterior insulation, over which double-perforated COR-TEN steel sheets will be placed on the auxiliary structure. The facades will feature large areas of glass and aluminium framing. The roof of the building will rest on the fourth-floor ceiling structure and will be inverted, with double-layer waterproofing and an exterior filtron slab finish with built-in insulation. The base will be comprised of a plinth made of Boñar limestone, the material used in León's major civic buildings.

THE BUILDING WILL HAVE a total of seven floors, two of which will be underground. The basement levels will house the installations, storage areas, archives and the technical rooms for the CRC, PSC and CTC, in addition to changing rooms, transformer and power generator. The ground floor will provide access to the facilities and will accommodate the High-Speed Line Authority and the technical workstations for the PSC and CTC. The PSC and High-Speed Line Authority will also occupy the first floor.

>OPEN FLOOR PLAN

Because the main CRC room will have a completely open floor plan, with approximate dimensions of 20x20 metres, it will be located on the third floor to avoid conditioning the structural solution for the building.

THE FOURTH FLOOR will be a mezzanine serving the CRC. This area will contain a large video wall (26 metres), adapted to the geometry of the room (see picture in page 40), which will enable operators to monitor railway traffic from 17 control stations. The building will have two underground levels, meaning that soil containment systems must be used. Because basement level 2 is located below the current ground level, an enclosure will be built using continuous reinforced concrete screens. Basement level 1 is above the current ground level, but will be located underground in the future, so reinforced concrete walls will be built to serve as containment elements. The building structure will be comprised of solid reinforced or prestressed concrete slabs, depending on the maximum spans to be covered. These slabs will rest on reinforced concrete pillars and on the basement screens and concrete walls, depending on the floor.

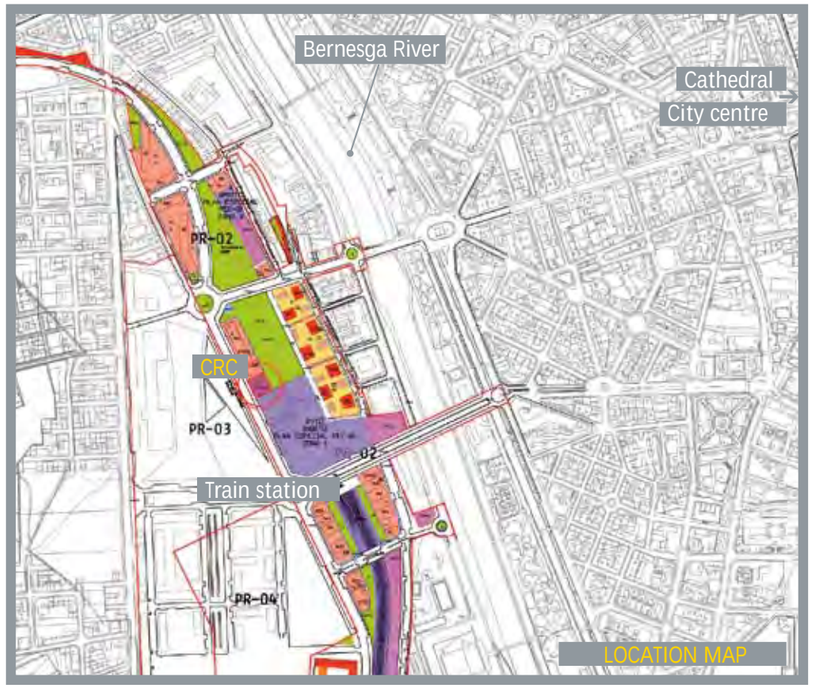
This infrastructure will control all railway traffic in the north and northeastern areas of Spain, and will manage most of the high-speed traffic between Madrid and the north.

MAIN ROOM OF THE CRC

These pictures show the most important room. It will be built on two levels, over which the crisis and visitor room will be located, allowing it to operate independently.

FLOOR PLANS

CONTROL ROOM FLOOR PLANS



LOCATION MAP

Specific details

>SUSTAINABILITY

The building will be constructed in accordance with the sustainability criteria established in the handbook 'Sustainable building 360º', containing the specific Corporate Social Responsibility actions undertaken by the Spanish Ministry of Development and Adif. This strategic planning takes into account environmental, economic and social criteria –such as comprehensive accessibility– throughout the design, construction and management process. As part of this initiative, the building will be equipped with solar panels on the roof.

>COMPARTMENTS

The partitions in most of the rooms will be plasterboard walls on galvanised steel framing, with a half-foot of rough brick, air brick or breeze block, to satisfy the thermal and acoustic needs of each room. In the offices, meeting rooms and other working areas glass partitions will be used.

>ELECTRICITY

Due to the amount of power required by the new building and exterior areas (1,200 kVA), the power supply will be high-voltage. This means that a distribution centre will be needed for the power company, and a subscriber-type transformation centre, due to the building's role as a nerve centre. Because extreme guarantees are required to ensure the operation of the facility, the electrical installation must be equipped with various backup and redundancy systems, defined on Adif's specifications.

>FINISHES

As far as interior finishes are concerned, the walls of the Regulation Rooms in the CRC, CTC and PSC will be lined with perforated solid cherry wood panels, with sound-absorbing insulation. The walls of the technical equipment rooms and installation rooms have been planned with a smooth acrylic paint finish. The two stairwells will be lined with porcelain stoneware tiles.

>ECOSYSTEM

The project includes the creation of five patios where landscaped areas will be designed in order to create a more inviting and colourful environment around the future building. For this purpose, a beach has been designed using white marble dust, mixed with tree wells and planters, which will house different plant species rooted in soil. Due to the water requirements of the species chosen, an irrigation system will be designed to cover any water deficits.

>URBAN DEVELOPMENT ASPECTS AND ANCILLARY ELEMENTS

The roof covering the transformation centre and power generator, which will be prepared for the passage of emergency and maintenance vehicles, will be paved with Boñar limestone paving stones placed over a bed of sand and later grouted over a double-layer waterproofing solution.

About to regain its full splendour

Ineco renovates the old Aranjuez railway station

Published in itransporte 23

Work is already underway on phase one of the renovation of the historic Aranjuez railway station in accordance with the project prepared by Ineco for Adif. This is one of Spain's oldest stations and is catalogued among the monuments at the Royal Site of Aranjuez, which was declared a Unesco World Heritage Site in 2001.

Restoration work began to refurbish Aranjuez station in the spring of 2011. The station, one of the oldest in Spain, belongs to the conventional Madrid–Alicante line and Line C2 on Madrid's commuter network (Cercanías).

The Neo-Mudéjar architectural complex dates back to 1923 and was designed by Spanish architect Narciso Clavería. It is included in the monument catalogue for the Royal Site of Aranjuez, which was declared a World Heritage Site by Unesco in 2001. Between 2007 and 2008, Ineco prepared the preliminary studies and complete renovation project for Adif, with a focus on respect for the original elements and design. These had deteriorated due to the passage of time and previous restorations using inadequate materials or techniques.

During the first phase of the project, which is scheduled to conclude in June 2012, the roof, mosaics and coffered ceiling in the lobby of the main passenger building are being refurbished.

The Spanish Ministry of Development has already approved the second phase, as part of the "1% cultural" programme run jointly with the Spanish Ministry of Culture, which will involve work on the remaining elements in the architectural complex: the surrounding areas, canopies, toilet building and underpasses. The existing underpass will be renovated and a new one will be built.

The main problems found by the Ineco specialists were cracks and damp in facades and interior walls in the buildings and underpass; defective, unwaterproofed roofs; collapsing supports on the coffered ceiling and decorated ceiling in the lobby, and serious deterioration of exterior elements (pinnacles, overhangs, cornices, etc.) at risk of falling onto public roadways. The woodwork and platform surfaces were also in poor condition and several unused buildings, such as the canteen and part of the old employee housing, were in a state of neglect. The roof canopies made of wrought iron and asbestos cement with glazing have foundation problems due to the deficient drainage system on the roof, which has been damaged by corrosion.

While some of these problems date back to the period when the buildings were constructed –such as the damp and leakage in the underpass–, others were caused or aggravated by previous restorations using inappropriate materials or techniques: coatings using paint that impedes water evaporation (damaging the stone), painting on glass, installation of false ceilings and successive redistributions of the space are some examples. ✱

AN ARCHITECTURAL JEWEL. In spite of the passage of time and previous restorations, the station retains its original style.

The station in detail

The passenger building is rectangular, 81.20 metres long and a maximum width of 13.80 metres. It has a basement, a ground floor with a central lobby and two side wings, as well as an upper floor that originally housed six dwellings for workers. The front and back facades are identical, except for the large central clock facing the patio. The lobby is decorated with a coffered ceiling, stained glass windows and mosaics with plant and animal motifs in geometric successions.
The three platforms were renovated around 1980 to adapt them to the trains and regulations that were current at the time. They are covered by steel canopies topped by asbestos cement and corrugated glass.
The complex also includes the building that housed the toilets and lamp room, which has a rectangular floor plan and a useful surface area of 64.54 m², and the old canteen, located under the so-called 'shed', with a total surface area of 430 m² between the passenger building and the toilet pavilion. This small detached building will be knocked down because it no longer serves any purpose.

DAMP. The waterproof paint on the plinths prevents the stone from breathing, causing damp to accumulate inside and disintegrating the porous material.

CORROSION. The deficient drainage on the canopy roofs has damaged the wooden false ceiling and corroded the metal.

To restore and preserve

MAIN ACTIONS_In the passenger building, the purpose of the renovation is to consolidate, restore and preserve all facing on the facades and in the lobby, as well as the interior finishes, such as floors, wall friezes, metalwork and woodwork.
As far as the rest of the complex is concerned, the main interventions will be the renovation and restoration of the old toilet building, disassembly and restoration of the canopies over the platforms, refurbishment of the platforms (including reinforcement and rectification of the edges), restoration of the underpass between the platforms and their stairs and stairwells, development of the areas next to or outside the platforms and buildings, and construction of a new underpass, including the installation of lifts and stairs. Along with the installation of ramps, this will make the station accessible to persons with reduced mobility.

UNDERGROUND MOSAICS_The restoration will help recover unique ornamental elements: the mosaics decorating the underground passage joining the platforms, similar to those in the passenger building. These works by the Genovese ceramist Mario Maragliano, who lived in Spain and also worked on the Palau de la Música in Barcelona and the Church of San Francisco el Grande in Madrid, lay forgotten for 51 years. They were hidden behind the brick walls that were used to turn the station's underpass into an air raid shelter during the Spanish Civil War, along with earth reinforcements on the outside and a concrete slab on the ceiling. They were discovered during the restoration process between 1995 and 1997, and protected by glass. This did prevent tessella loss, but aggravated the deterioration caused by moisture. During the renovation project, the mosaics will be restored and the glass panels removed.

Transparency and spatial unity

New AVE Club Class lounges in Valencia and Albacete

Interior design

Published in itransporte 39

Renfe Operadora hired Ineco to provide site management and draw up the interior design projects for the AVE Club Class lounges for the Valencia and Albacete stations and their Service Centres.

As a service for AVE Club Class passengers, a specific lounge is provided to serve as a waiting area with all the comforts. Although the city of Valencia is a major tourist destination, the AVE Club Class lounges in Valencia and Albacete are aimed at business travellers, who comprise the majority of Spanish high-speed rail passengers.

While drawing up the project for the AVE Club Class lounge in Valencia, Ineco was assisted by the strategic business consultancy firm DEGW, which performed preliminary data collection to compile a list of needs.

The new lounge was not intended merely as a waiting area, but would offer travellers a place to hold meetings, work, connect to the Internet or simply relax. Due to this complexity, it was decided that a mezzanine would be included as part of the project.

Because of its accessibility and ease of use, the ground floor is devoted to more dynamic activities. The lounges have been placed away from the side facades to allow the entry of natural light, preserve the spatial quality of the existing double height and provide greater spatial diversity. Located on the central axis, but at the back of the lounge, is the catering and cafeteria area. Although the Albacete lounge is smaller, the same design criteria used in Valencia were followed. ✱

VERTICAL LINK
Dominating the AVE Club Class lounge in Valencia is a curved glass stairway providing a vertical link between levels. The stairway is located in the centre of the lounge, enhanced by a suspended light fixture that accentuates its verticality.

Service Centres

Renfe Operadora Service Centres were planned for all stations along the Madrid–Valencia corridor. A space was prepared at each station, featuring a waiting area, customer service desks and a working area for employees. The reception desks for the AVE Club Class lounges are still being designed, and others are being created to meet customer service needs. These desks will be located in the middle of the room, dividing the space into public and a private working area for personnel. A touch of colour will be provided by the furnishings and the light fixtures suspended over the desks.

The upper level houses those areas specially designed for work and meetings.

Madrid-Barajas raises the standards

Ineco supported Aena during the certification process

Published in itransporte 40

Attainment of the Aerodrome Certificate by Madrid-Barajas Airport, formalised by Aena and Spain's National Aviation Safety Agency (AESA) in April 2011, marks the culmination of a complex process that reaffirms the airport's commitment to operational safety.

The Aerodrome Certificate represents international recognition of compliance with the highest operational safety standards by Madrid-Barajas International Airport. Ineco participated in the entire certification process and provided Aena with a multidisciplinary team of over 25 experts, who also took part in the certification processes for other airports in Spain.

The certification requirement has its origins in International Civil Aviation Organization's (ICAO) recognition of the need to unify operational safety requirements in civil aviation. The main points were covered in Document 9774, the *Manual on Certification of Aerodromes*, which establishes that each State must implement national legislation containing technical standards for the design and operation of aerodromes, and must include a certification requirement to ensure that aerodrome operators meet their obligations under the applicable regulations. In Spain, ICAO regulations concerning technical standards and certification have been incorporated into our legislation through Royal Decree 862/2009.

To conclude the process and to ensure that each State complies with the regulations, ICAO has established a Universal Safety Oversight Audit Programme (USOAP) to monitor the degree of compliance with ICAO regulations by airports, as well as the quality of surveillance exercised by the Civil Aviation Authority over operators in each State. The USOAP performs regular and standardised audits of the practices implemented by the aviation authorities.

The certification process involves an enormous amount of effort. In order to optimise the process and make it more systematic, three basic pillars have been established: the Airport Manual, the Technical Standard Compliance Report and the Operational Safety Management System (SMS). ✱

PHOTO BY PABLO NEUSTADT

EXPERIENCE GAINED

The experience that Ineco has acquired by participating in SMS implementation at Aena's 47 airports has confirmed that the most important thing is not only to strengthen the weak points, but to consider how to consolidate the strengths. This aspect has shown that in good SMS management, it is more important to identify future needs than to react to past events. The process of certifying Spain's airports, starting with Madrid-Barajas, is a profound learning experience. Without a doubt, the fact that the first Spanish airport to formalise its certification in accordance with ICAO standards is precisely the one with the highest traffic (with over 50 million passengers and 400,000 operations annually) has certainly been an ambitious challenge.

The Manual

THE BIBLE FOR OPERATIONAL PROCEDURES_The Airport Manual contains the most relevant operational procedures, ranging from how information should be published in the AIP (Aeronautical information Publication) to wildlife hazard management, in addition to vehicle management on the apron, visual aid maintenance and coordination with air navigation services. There are up to 19 general procedures at Madrid-Barajas International Airport, supported by over 200 lower-level local operating procedures.

The Report

VERIFIABLE RECOMMENDATIONS ON THE STANDARDS_The Report of Compliance with Technical Standards is the document used by airport operators to prove compliance with airport design and operating standards, using all technical and procedural documentation at their disposal. To give us an idea of the magnitude of this task, Annex 14 (on which Royal Decree 862/2009 is based) contains about 1,000 standards and recommended methods, which must be verified and justified before the authorities one by one. It is not difficult to imagine that completing such a document requires the airport operator to undertake a thorough internal auditing process and a detailed analysis of the condition of the infrastructure. During this analysis, any deviations from compliance with standards and recommendations should be detected. In this way, the appropriate corrective measures can be taken, or Aviation Safety Studies can be conducted to determine whether the alternative measures proposed by the operator sufficiently guarantee the maintenance of an equivalent level of operational safety.

The SMS

A CONTINUOUS IMPROVEMENT SYSTEM FOR EVALUATING DEFICIENCIES_The Operational Safety Management System (SMS) is a continuous improvement system that identifies deficiencies and aspects to improve, and proposes solutions which are later monitored. However, the SMS differs from quality management systems in that it directly affects the safety of the persons using the service, and not only the service quality. The first step towards implementing an SMS is to assess the actual situation and any deviations from the desired scenario. This identification process, known as 'gap analysis', enables the airport to establish its operational safety targets. Once the reference has been established, a potential risk detection phase must be carried out. The operator must then undertake the actions required to close the gap between the actual and desired situations, and must be proactive, anticipate events and correctly interpret the scenario. It is worth highlighting that SMS is a live system that needs to be integrated into the daily life of the airport and requires constant monitoring and attention.

‘The certificate requires everyone’s involvement’

Miguel Ángel Oleaga

Director of Madrid-Barajas International Airport

Miguel Ángel Oleaga (born on Oñate, Spain, 1949) has been head of Madrid-Barajas International Airport since November 2001. In this interview, he offers an assessment of what obtaining the AESA Aerodrome Certificate means to Madrid’s monumental airport, and explains how this objective was achieved.

Oleaga, an aeronautical engineer, has been directing Madrid-Barajas for 14 years (the first four as Deputy Director). He held a number of positions during his long career at Aena, including Airport Operations and Services Director for the entire network.

Barajas was the first Spanish airport to achieve AESA Aerodrome Certification in accordance with ICAO standards, an indispensable requirement for all airports starting in 2016. Was it difficult?

The Madrid-Barajas certification required an exhaustive internal audit of the degree of compliance with over 1,000 technical standards, implementation of new operational safety management procedures, preparation of aeronautical safety studies, etc. Achieving this goal required over two years of work and coordination by a multidisciplinary group.

What aspects of this international requirement would you highlight?

I would point out that for the first time, an independent entity external to Aena has accredited that our airport meets the highest operational safety standards.

Does that translate to higher management efficiency?

Proactive, systematic identification of risks during operation represents a clear improvement in the overall functioning of the airport, not only in terms of safety, but in all other areas of airport management over the medium and long term.

Is the experience with this process being shared with other Spanish airports that are working towards the same goal?

Through Aena Central Services, the airport has made the experience and learning acquired available to the rest of the Spanish network. In addition, personnel from other airports undergoing the certification process have participated as observers at important moments in the process, and were provided with all kinds of information, tools and documentation used by Madrid-Barajas.

Once the certificate has been obtained, what does maintaining it involve for the airport?

The task of maintaining the certificate is as important, or more, than obtaining it. We have implemented a Safety Management System that involves the entire airport, both Aena personnel and external companies. Operational safety is everyone’s responsibility.

Does the certificate help to make an airport more attractive to potential new users?

The certificate represents an aeronautical operational safety guarantee for all users, and I think it is an incentive for potential new users to know for certain that the airport they are coming to has met all requirements set by both national and international authorities.

‘The work performed by Ineco through the different technical assistance contracts has been outstanding (...) They also helped draw up Aeronautical Safety Studies’

Ineco has been supporting Aena in the process of obtaining the certification... What do you think of the support provided by the company throughout the process?

The work performed by Ineco through the different technical assistance contracts has been outstanding. Some examples I would mention, among others, are the support provided to the Operational Safety Department during the implementation of the Safety Management System, and to the airport’s Technical Office during the preparation of technical documentation. Through the DOSR, Ineco also helped draw up Aeronautical Safety Studies. ✱

PHOTOS BY PABLO NEUSTADT

PHOTO COURTESY OF AENA

MADRID BARAJAS, AMONG THE BEST IN THE WORLD

In addition to being Spain’s busiest airport in terms of passengers, air cargo and operations, Madrid-Barajas is now Europe’s fourth largest airport by passenger traffic. The international airport recently received the ‘Global Airport of the Year 2011’ award, granted by the Institute of Transport Management (ITM), in recognition of its leadership position among the world’s airports.

According to the latest data provided by Airports Council International (ACI), in 2010 Madrid-Barajas ranked 12th among the world’s airports by number of passengers (49.63 million, surpassing airports of the calibre of Amsterdam-Schiphol), while ranking 17th in the world by number of operations (more than 426,000).

A single sky for everyone

The International Civil Aviation Organisation, a global body integrating the skies

Published in itransporte 43

Since it was established in 1944, the International Civil Aviation Organisation (ICAO) has become indispensable for air transport. Ineco has maintained in recent years a close relationship with this organisation through the Technical Cooperation Programme.

Year 2030: 5,000 million passengers on board of more than 50 million aircraft are travelling on air highways and taking off from over 10,000 airports located all over the world... This is not a scene from Ridley Scott's *Blade Runner*. These are forecasts issued by international organisations. These numbers did not come from a science fiction writer's imagination, or the screenplay for an apocalyptic movie, but are likely scenarios for a rather near future.

No-one can predict the future. We can speculate, but you really don't need to be an expert in traffic estimation to believe that the situation described is quite capable of becoming reality, not some wild fantasy from a visionary. More than 26 million operations took place over 2009. All this in 185 countries against a backdrop of different ideologies, languages, technologies and economies and with different standards and legal systems.

The system supporting air transport is not local, insular or isolated. Quite the contrary. It needs globality and openness in the markets. Its development and survival require communication and interrelationships between all of the countries in the global network. Such interdependence, while hardly easy, is indispensable. It requires the establishment of basic rules and an independent body to guarantee, safeguard and defend them, while also protecting the common interests of its member states.

This need became apparent at the dawn of the 20th century, at the Paris Convention of 1919. However, it would only be after World War II, at the Chicago Convention, when it would come to be seen as obligatory. The International Civil Aviation Organisation (ICAO) was established by this Convention in 1944 as an agency of the United Nations, for the purpose of promoting, stimulating and supporting worldwide air transport through the harmonious, unified and coherent development of all instruments participating in it: airports and navigation, airlines, aeronautical service providers, etc., to ensure safety and efficiency, as well as equity between all contracting states.

We have come a long way since that November in 1944, in which representatives from 52 countries met with that goal in mind. And there is still a way to go. But the path has been laid and we should make sure that the means are available for everyone to follow it. It is also true that while some are guided by sophisticated GPS equipment, others still make use of the modest compass.

The steps which need to be taken to bring these two worlds closer together in the complex world of air transportation are slow, due to the enormous differences between countries, but sure. The ICAO, thanks to its Assembly, Council and different Commissions, keep track of the path and make sure all the members are following it in order to achieve a unified aviation scheme with respect to safety, equality, sustainability and environmental friendliness.

REALITY OR FICTION? For 2030, it is foreseen that more than 50 million aircraft will fly around the world. The future might no be diferent from what the classic authors of science-fiction literature were telling us.

The work performed by the ICAO, which is indispensable in every sense, is not limited to normative and regulatory functions. These are supplemented by support and technical assistance to any of its member states requesting help in order to meet any need arising from the maintenance of aviation-related installations or infrastructures, compliance with standards and regulations issued by the organisation itself, or any other eventualities in the transport system.

To this end, the ICAO maintains a yearly Technical Cooperation Programme in order to respond to the specific technical difficulties that may be encountered by any of its member states. In 2010, a total of 197 projects were undertaken in 95 countries as part of this Technical Cooperation Programme: studies ranging from the improvement of operational safety in air transport to efficient, sustainable operation –both economically and environmentally for the systems supporting world aviation–, to strategic plans, evaluations of organisational structures, assessments for preparing safety audits, airport certification, etc.

For preparing the different studies, in addition to its own personnel, the ICAO receives assistance from numerous experts and international consultancy firms specialising in the field of aviation and airport and navigation infrastructures. The extra value of this collaborations is not small, for the ICAO itself as well as recipient countries and for companies and experts, because it guarantees the technical reliability of the offers and the fulfilment of the contractual requirements. *

Ineco and ICAO →

>COMPREHENSIVE PLAN FOR THE MODERNISATION OF COSTA RICA'S NATIONAL AERODROME NETWORK

Developed during 2010, the plan identifies and evaluates the modernisation needs and possible expansions for Costa Rica's airport and aerodrome system. The plan analyses the need to build new airports, redefines possible specialisation strategies in accordance with the potential uses (passengers, cargo, tourism, general aviation), studies private sector participation formulas and provides an airport infrastructure policy planning tool. The project is supplemented by a study of the site alternatives for a new international airport.

>STRATEGIC PLAN FOR AIRPORT DEVELOPMENT IN PANAMA

Establishes the guidelines or action proposals for developing Panama's airports and to prepare them to take advantage of the opportunities offered by air travel for Panama and the Americas in general.

>AIRPORT SAFEGUARDING. AIRPORT VICINITY AND PROTECTION AREA STUDY (AVPA) FOR THE SULTANATE OF OMAN

Ineco is currently collaborating with Oman's Civil Aviation Authority (CAA) to develop the plans that will ensure compatibility between airports and the surrounding areas. The objective of these plans, known as Airport Vicinity Protection Area (AVPA) Plans, is to ensure the safety and regularity of the operations at each airport so that the development of the airport environment does not affect its certification process or future growth.

‘Operational safety is our primary strategic objective’

Roberto Kobeh

President of the ICAO Council

Roberto Kobeh, born in Huixtla (Chiapas), Mexico, in 1943, was elected President of the Council of the ICAO for the first time in 2006, a position he still holds. Throughout his career, he has held different positions with Mexico’s Civil Aviation Authority (CAA), within the Secretariat of Communications and Transport (SCT).

Of the organisation’s objectives, where would you place operational safety?
Operational safety is ICAO’s primary strategic objective, followed by the protection of aviation, the environment and the sustainable development of global air transport. With regard to safety, our most recent initiatives are related to runway safety (accidents on runways are today the number-one cause of aviation fatalities), fatigue risk management and training for the next generation of aviation professionals.

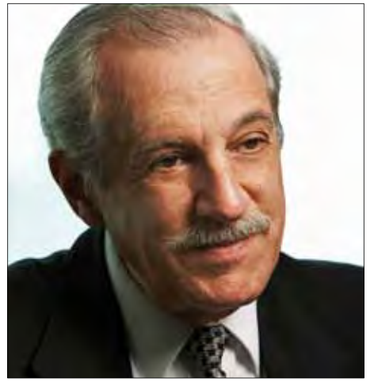
What kind of cooperation do you need from member states to guarantee safety?
For progress in international civil aviation, commitment and cooperation from our member states is essential for implementing ICAO standards and recommended practices (SARP). Cooperation between member states is also necessary, and between member states and all parties in the aeronautical community (airlines, airports, manufacturers, air navigation service providers and other sectors with interests in the aviation industry) who help promote the integrity of the global air transport system.

I would also include the governmental bodies and financial organisations who contribute positively to promoting the general sustainability of international civil aviation.

Your organisation has not supported the European Commission’s proposal to create a worldwide ‘black list’ of companies that do not meet ICAO requirements. Why not?
Our objective is to help countries so that their aviation systems comply with ICAO standards. We continue to make progress in that direction. Over the long term, I am convinced that this approach will yield results that will benefit everyone.

What do you consider the most appropriate global actions for improving aviation safety?
The specific actions vary depending on the country, the region, and the local circumstances. One of the mechanisms we are promoting among countries with relatively little aviation activity is the creation of Regional Safety Oversight Organisations (RSOO).

Given the large differences in infrastructure, facilities, systems and resources between member states, is it viable to consider adopting global measures?
Yes, of course, without a doubt... An aircraft requires the same air navigation facilities and standard systems anywhere in the world. That is why globally harmonised regulations are essential for guaranteeing the safety and effectiveness of the global air transport system. Although there may be differences in the facilities and services offered, these regulations must always be met.



How would you rate the progress in airspace unification, or the ‘Single Sky’, compared to initiatives such as NextGen in the United States or the SESAR programme in Europe?
Important progress is being achieved. Last September, the ICAO held a worldwide symposium on the air navigation industry which reviewed the technical and political issues involved in designing and implementing a globally interoperable aviation system. Over the next 10 years, more than $120 billion (€92 billion) will be invested worldwide to transform the system, and it is essential that we join forces to make this global project a reality.

The ICAO recently announced that it will prepare new environmental protection measures. What progress has been made in this area?
The ICAO Assembly held in 2010 passed a historic resolution that made international aviation the first sector with global targets and aspirations for improving fuel efficiency by 2% annually and stabilising its global carbon dioxide (CO_2) emissions at 2020 levels. This resolution includes the development of a CO_2 emission certification standard for aircraft, with 2013 as its deadline, the development of market-based measures (MBMs) for international civil aviation, and the development and permanent implementation of alternative and sustainable fuels for aviation.

Of particular importance are the action plans that will enable countries to identify the measures they want to adopt to stop climate change, and the help they will need. The ICAO has already prepared different orientation material and an interactive website to support their efforts.

Your forecasts for 2030 show a significant increase in worldwide air traffic. What regions and types of traffic should expect the greatest changes?
Our forecast calls for an average growth rate of 4.5% worldwide between 2011 and 2030. This figure is in line with the economic projections for that period. The greatest increases in air traffic will occur basically in the Asia-Pacific region, followed by the Middle East and Latin America.

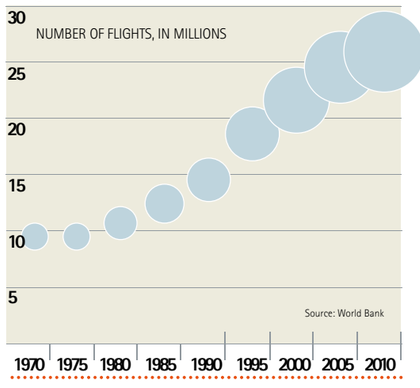
The ICAO, through its Technical Cooperation Division, has entered the field of engineering and consultancy as an observer, guaranteeing the transparency and technical solvency of studies and projects for the development of airport and air transport infrastructures. What future possibilities do you see for cooperating with the organisation’s member countries?
The ICAO’s Technical Cooperation Bureau (TCB) has a long history of neutrality, transparency and objectivity. Our clients trust the integrity and responsibility of TCB experts.

The ICAO is doing everything it can to expand its services in order to respond to the needs of its member states in three specific areas: queries in essential technical and operational areas, equipment procurement and training programmes. ✱

AVIATION SAFETY, UNDER DEBATE IN MADRID

In March 2011, the seminar entitled ‘Safety Information: Cooperation Between Aeronautical and Judicial Authorities’ was held at the Congress of Deputies in Madrid. It was organised by the ICAO and the Official Association of Commercial Aviation Pilots (COPAC). In the picture above, Roberto Kobeh (right), with Manuel Bautista, director of Ineco’s Aula Carlos Roa, during a break between lectures.

WORLDWIDE AIR TRAFFIC

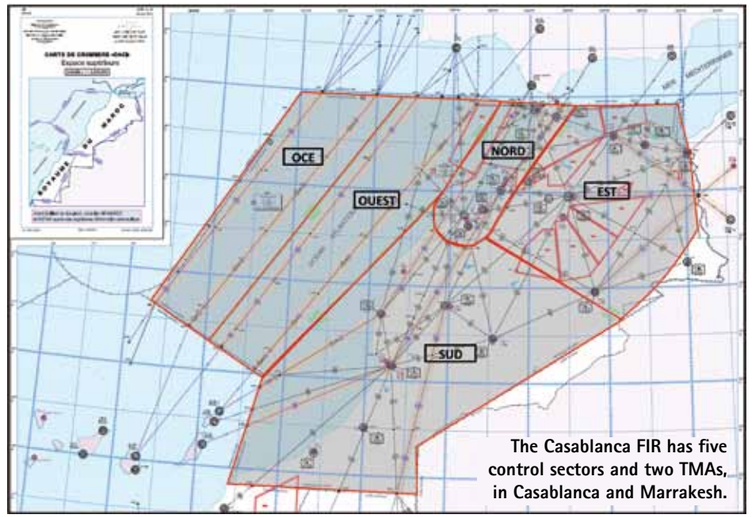


Morocco reorganises its skies

Analysis of aircraft movements at Moroccan airports

Published in itransporte 41

Ineco belongs to an international consortium, along with Egis, Avia and Isdefe, which is responsible for drawing up the project entitled 'Study, analysis and reorganisation of the airspace of Morocco' in order to develop a new air navigation system for the African country. The first phase in the delivery of the technical report ended in July 2011.



The Casablanca FIR has five control sectors and two TMAs, in Casablanca and Marrakesh.

The project entitled *Study, analysis and reorganisation of the airspace of Morocco* is part of the Strategic Plan of the Kingdom of Morocco for the development of its flourishing tourism industry and its Airport and Air Navigation System. To improve the simulation scenario, an aircraft movement capacity study was recently conducted for Morocco's main airports. In connection with this plan, Ineco is studying the current and future capacity of the terminal building at Mohammed V International Airport in Casablanca for the Moroccan Civil Aviation Authority, in accordance with the existing infrastructure improvement plans.

Morocco is associated with EUROCONTROL and is committed to the Single European Sky project. The African country also participates actively in the regional group AEFMP (Algeria, Spain, France, Morocco and Portugal), which has achieved notable progress in the development of the region's air navigation system during its 20 years of existence. ✱

Monitoring committee

Meeting of the monitoring committee at the Casablanca Control Centre, in June 2011.

Casablanca Control Centre

PROJECT PHASES

>PHASE I / EVALUATING THE SYSTEM

With a duration of six months, Phase I serves to evaluate the capacity of Morocco's air navigation system and to prepare a traffic forecast for the years 2012, 2015, 2020 and 2025 based on three growth scenarios: high, medium and low. This evaluation includes the changes planned by the Office National des Aéroports for an initial validation. These projects are the new TMAs (Terminal Areas) at Fez and Marrakesh airports, as well as an evaluation of the current TMA in Casablanca.

The evaluation is conducted with accelerated simulation techniques using RAMS, a system developed by EUROCONTROL which makes it possible to perform a quick, reliable analysis of air traffic control systems in terms of controller workloads and the detection of aircraft conflict points. This evaluation will be completed using the data obtained by Ineco personnel through direct observations.

THE RESULT of the evaluation of the current air navigation system will be a set of recommendations for easy and quick implementation that will solve some of the deficiencies identified.

>PHASE II / SIMULATION, FORECASTS AND EFFICIENCY

An accelerated simulation will be developed in Phase II, with the scenario improved by the recommendations and traffic forecasts developed during Phase I in order to determine the capacity limit for this system and the saturation levels that will be produced. During Phase II, a new scenario for the air navigation system will be developed and will include an improved airway network and a new sectorisation and organisation of Morocco's airspace.

This process is iterative until the model eventually submitted meets the safety objectives (which require a specific study) and the capacity and efficiency targets during an accelerated simulation.

THE EFFICIENCY PARAMETER should be measured from the air perspective (situation for the airlines) and the ground perspective (air navigation service provider). With regard to sectorisation, the number of sectors must be as close as possible to the operational needs during peak times, while being flexible enough to adapt to periods of lower demand.

>PHASE III / IMPLEMENTATION PLAN

This last phase is divided in two: the determination of the operational concept and the creation of an Implementation Plan, along with the associated safety study.

For the operational concept, defined at the level permitted by the project time frames, it will be necessary to define the navigation system used to construct the new airway system and the CNS needs associated with this type of navigation. This involves analysing existing infrastructures and determining the improvements needed to meet the requirements.

As far as ATM is concerned, ATC systems will be evaluated to determine the improvements needed for operation in the new scenario and the controller support tools, such as medium- and short-term conflict alerts, ATC system interoperability with collateral control centres and internal civilian and military ATC units, as well as their ability to adapt to the new technologies developed within the Single European Sky project.

ANALYSES WILL BE PERFORMED and the necessary recommendations will be made so that the current FMP (Flow Management Position) can develop ATFCM (Air Traffic Flow and Capacity Management) features in accordance with the procedures established by EUROCONTROL. In this area, airspace management and civilian-military coordination for implementing the concept of 'flexible airspace use' will be essential to the development and efficiency of the new scenario.

Finally, an Implementation Plan will be created for the new scenario, along with an analysis of its risks.

AERONAUTICAL | **JAMAICA**① | Airport expansion

New horizons for Jamaica's main tourist airport

Ineco's second project for Sangster International

Published in itransporte 39

After entrusting Ineco with their Master Plan in 2009, the airport operators have turned to the company once again to plan a series of crucial actions for their future, including the expansion of their only runway.

Sangster International Airport (IATA code SIA), located in the city of Montego Bay, is the main tourist gateway to Jamaica. In 2003, the Jamaican government transferred its management to the international consortium MBJ Airports Limited, which hired Ineco in 2009 to prepare a Master Plan to analyse and plan the airport's expansion over the next 20 years.

The proposals in this document included improvements in the installations and access roads, and actions to adapt the runways and apron to ICAO regulations. For example, the Master Plan concluded that lengthening the runway to 3,000 metres, and thereby making large aircraft operations possible, is a strategic action because it will open up distant markets.

MBJ Airports Limited hired Ineco again in October 2010, this time to draw up a project including nine of these crucial actions.

The new venture is divided into two stages: preliminary design and detailed design. During this period, the Ineco team placed special emphasis on analysing the areas of greatest economic impact for the project, such as the rehabilitation of the runway pavement and the solution for embankment formation during the expansion. Once the preliminary design is approved, the next phase is the tender to award the execution of the construction project. The project drawings and budget per unit will also be developed in detail. ✱

PRELIMINARY TASKS

Ineco provided technical support for tasks performed before the project was drawn up: destructive and non-destructive tests to analyse the condition of the runway pavement, a geotechnical study and a detailed topographical survey of the entire project area.

ACTIONS PLANNED

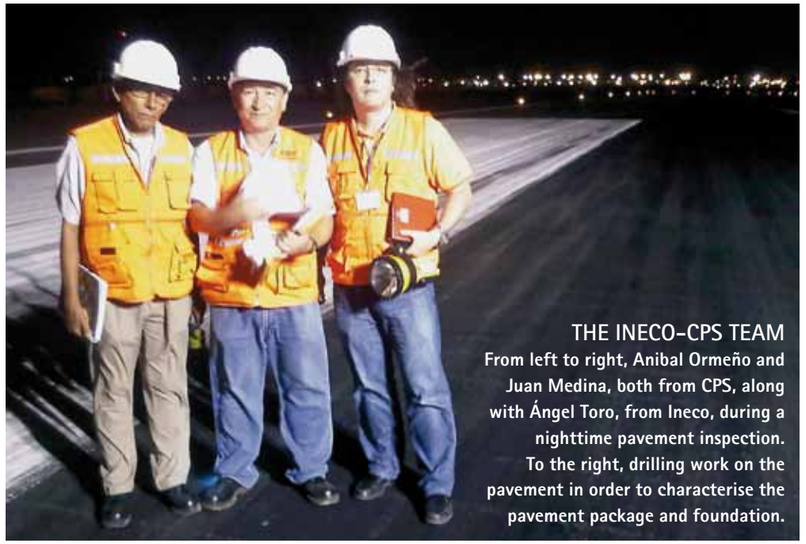
- Runway expansion (400 m).
- Rehabilitation of the pavement on the existing runway.
- Runway end safety areas (RESA) on both ends (92x90 m on the 07 end and 240×150 m on the 25 end).
- Displacement of runway threshold 07.
- Construction of runway shoulders.
- Adjustment of taxiway E on the apron.
- Construction of a perimeter road covering the entire perimeter of the runway area.
- Relocation of the Fire Hall, more centred in the new runway configuration. Demolition of the existing building.
- Repositioning of the area of Kent Avenue affected by the construction and relocation of a drainage canal outside the airport.

AERONAUTICAL | **PERU**② | Structural improvement

Runway ready for takeoff

Rehabilitation work at Lima-Callao Airport

Published in itransporte 38



THE INECO-CPS TEAM

From left to right, Anibal Ormeño and Juan Medina, both from CPS, along with Ángel Toro, from Ineco, during a nighttime pavement inspection. To the right, drilling work on the pavement in order to characterise the pavement package and foundation.

Jorge Chávez International Airport, in the Peruvian capital, is one of the busiest in South America, with over 8.8 million passengers per year. Ineco, in a consortium with the local company CPS, carried out the runway rehabilitation and maintenance work.

The LAP consortium (Lima Airport Partners, with German and Peruvian participation) has been responsible for operating the Andean country's main airport since 2000. The maintenance and structural improvement of the runway pavement, originally built with concrete slabs covered with hot mix asphalt, was one of the investment commitments for the expansion of the airport.

Preliminary studies conducted for the LAP consortium concluded that the residual life of the pavement should have been coming to an end around 2010. A tender was therefore held in December 2009 for the rehabilitation and maintenance work, which was awarded to Ineco in association with the Peruvian engineering firm CPS. The work was carried out in four stages.

First, a series of field studies were conducted. These included a topographical survey with level survey, a geotechnical study of the pavement foundation layers, determination of the PCI (Pavement Condition Index) and non-destructive tests using an HWD (Heavy Weight Deflectometer). Such tests assessed the bearing capacity of the pavement in order to determine its residual life.

During the second stage of the project, the client was advised on the optimal way to plan actions on the runway and minimise the impact on aircraft operations at the airport. For this purpose, an analysis was performed of the investments and projects planned in the medium and long term, traffic forecasts, timetables for the most profitable operations, returns from paving and beaconing tasks, machinery availability, etc.

During the third phase, once the schedule for the investments planned had been agreed with the client, the Ineco-CPS consortium developed the detailed engineering on which the tender would be based.

Finally, the Ineco-CPS consortium prepared the specifications and the necessary documentation for the tendering and supervision of the work. ✱

A quick hop across the Strait

Ceuta is now just 10 minutes from Algeciras thanks to a new heliport

Published in itransporte 27

Since July 2010, this second heliport in the Aena airport network has connected the autonomous city of Ceuta to the port of Algeciras over the Strait of Gibraltar. Ineco drew up the project and was in charge of site management.

Since it was officially inaugurated in July 2010, over 17,000 passengers have travelled on regular flights, at the rate of five flights per day. The new Algeciras heliport is the second in the Aena airport network after Ceuta and responds to a growing demand: more than 2.5 million people cross the Strait of Gibraltar to or from Ceuta every year.

It now takes a ferry about 60 minutes to cover the distance separating the Spanish autonomous city from Algeciras. The quickest alternative is the heliport: the regular passenger line managed by the Spanish group INAER, linking the Ceuta heliport to Málaga Airport, takes approximately 35 minutes, and was the only line of its kind in the country until recently.

The opening of the Algeciras heliport has provided the citizens of Ceuta with a third direct link, and the fastest of the existing ones. In addition to being fast, the advantage of this line (which continues to Málaga) is that it provides an alternative to the ferry service, which is frequently affected by severe weather events, such as Levante storms, resulting in cancellations. *

A high-level 'nest'

The heliport is located on top of the parking garage at the Algeciras maritime station. To avoid interfering with ship operations, another level was added to the existing building, with characteristics and dimensions similar to those of the three previous levels. The new roof is situated at a height of 19.45 metres and has a total surface area of 6,850 m².

On the roof is the helipad platform, measuring 43.6 x 55.7 metres, at a height of 30 metres (equivalent to an 8-storey building). These dimensions were calculated using the Bell 412 EP helicopter as a reference. This model, with a capacity of 12 to 14 passengers per flight, was used until 2006 on the Ceuta–Málaga line. Passengers enter through a tower equipped with stairs and two lifts, with capacity for 13 people each. It is accessed from the departure lounge, located on the ground floor.

The passenger terminal was built by remodelling a 650 m² area of the old maritime terminal building, where tickets are sold, baggage is checked, security checks are performed, and access to the technical and security block is provided.

GRID

The helipad platform is supported by a spatial mesh structure measuring roughly 2,400 m², which was built on 24 pillars.

SAFETY NET

A safety net 2 metres wide has been installed around the entire perimeter. It must withstand a weight of at least 75 kg.

WALKWAY

A walkway was installed under the helipad, equipped with a partition separating the departure and arrival flows.

VERTICAL ACCESS CORE

All passengers will access the platform via an access core featuring 2 lifts and an evacuation stairway.

INECO AT THE HELIPORT

In addition to drawing up the construction project, Ineco personnel monitored the execution of the project, ensuring that the quality conditions required by Aena in the technical specifications were maintained. Ineco (in the picture above, part of the site personnel) was also in charge of budget control, project review, supervision and control of the quality plan for the contract, geometric control, qualitative and quantitative control of materials and execution, control of the work schedule (which included drawing up modified projects), health and safety coordination and environmental monitoring, and has taken on Site Management responsibilities. Because this is a new facility, rather than a remodelling or expansion of an existing one, no Aena personnel have been posted to Algeciras. Work had been taken place on land owned by the Algeciras Bay Port Authority (APBA), which was ceded to Aena for the execution of the project. It was therefore a challenge to coordinate and mediate between the different entities involved in the project, including relations between Aena, the contractor and the APBA.

AERONAUTICAL | **SPAIN** | Airport enlargement

A new terminal under the domes

70% of Alicante Airport's traffic is international

Expansion project

Published in itransporte 39

The new terminal building at Alicante Airport, right on the Mediterranean coast, has doubled its capacity and can now handle 20 million passengers per year. It was inaugurated in March 2011.

Domes viewed from inside the boarding area.

Aena (the Spanish operator of airport services and air navigation) has responded to the problem of the high level of traffic saturation at Alicante Airport with a new 333,500 m² terminal building and a departures hall crowned by 40 semispherical domes. The facilities, inaugurated in March 2011, feature five check-in islands with 96 desks, another two desks for oversized baggage, 26 boarding gates (15 with telescopic boarding bridges), extensive shopping areas and a 1,000 m² VIP lounge.

The baggage claim area occupies 13,000 m² and is equipped with 14 belts, plus two additional belts for oversized baggage. The new terminal also has 12 carousels for arrivals and another 15 for departures in the baggage handling areas, managed by a BHS (Automated Baggage Handling System) with a total length of 18 kilometres of conveyors and a processing capacity of 7,880 baggage items per hour.

There are 57 bus platforms at the exit from the terminal building, along with a new parking garage with six levels and a capacity of 4,200 spaces. In addition, an electrical power plant and thermal-frigorific plant are now in service, responsible for feeding 11 new transformation centres and the climate control units. The apron has been expanded from 225,000 m² to 439,000 m², and 10 new positions have been added to achieve a total of 46. ✱

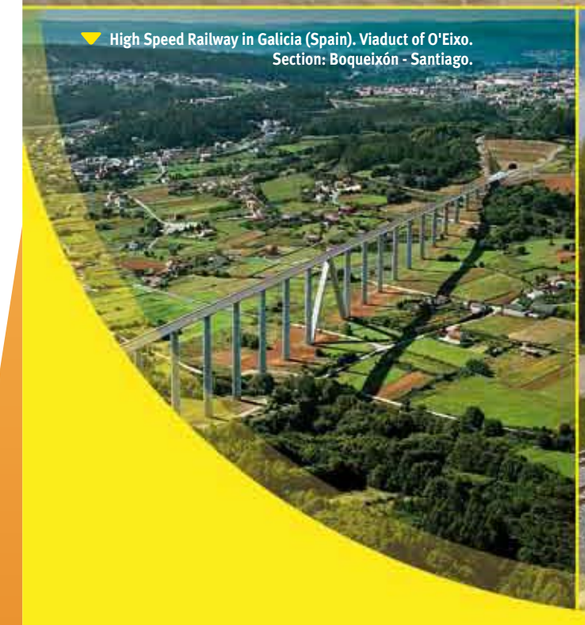
The new terminal building, officially inaugurated by the Spanish government on March 23, 2011, now occupies a total of 333,500 m².

Ineco in Alicante

Ineco was hired in the year 2005 to provide services to Aena as part of the Levante Plan and has participated in the coordination, project management and action plan for commissioning (see Issue 2 of itransporte English Edition). In the first case, the tasks undertaken by Ineco included technical support and consultancy services to the site managers, coordination between the airport operator and the companies involved in the project (20 contractor companies, 14 site control and surveillance engineering firms, and a further 7 project drafting firms), time management and monitoring of over 5,000 activities, environmental management and control of the final project documentation. Ineco also performed other tasks: drawing up some of the expansion projects and the monitoring, surveillance and execution of certain parts, such as the Integrated Security System.

The first flight operated from the new terminal building took place early in the morning of March 24, 2011, bound for the airport of Memmingen (Germany). No incidents were recorded.

High Speed Railway. Ankara - Istanbul (Turkey).



High Speed Railway in Galicia (Spain). Viaduct of O'Eixo. Section: Boqueixón - Santiago.

Reconstruction of the Pan-European Corridor no. 4. Section: Krasikov - Caská Trebová, in Trebovice (Czech Republic).

Icarus' dream

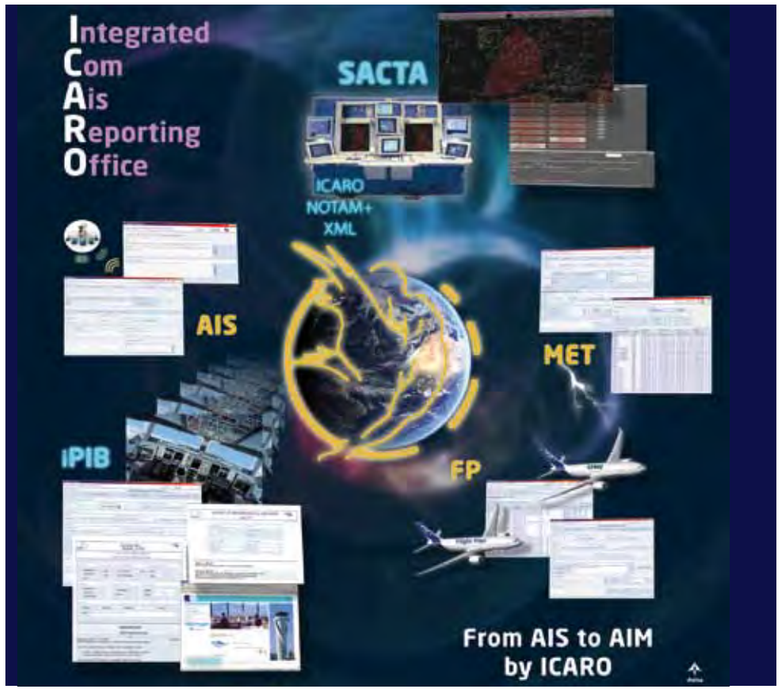
From teletype to the automation of the aeronautical, meteorological and communications information system

Published in itransporte 33

ICARO, a tool created in the early 1990s, is essential to air traffic management in Spain. Ineco is actively participating in the implementation of the new version of this system in Spain's airports.

ICARO (Integrated COM/AIS/AIP & Reporting Office Automated System) is the integrated system that automates the management of the aeronautical, flight plan and meteorological information required for air operations. With this powerful tool, users preparing to start a flight can access the information needed to plan the route and file a flight plan, along with any relevant meteorological and aeronautical information.

The pilot or airline must submit a form containing flight plan information to the aviation authorities so that the flight can be monitored from the tower and control centres. The flight plan includes information on the departure time, origin and destination, route, flight duration, type (civilian or military), rules (instrument or visual), and other data of interest.



Constant evolution

The ICARO 2000 system had a distributed architecture (a large number of servers located at multiple sites), resulting in more expensive system maintenance and administration, a costly communications infrastructure and complex information replication between different databases on different servers, among other considerations.

After a number of analyses, a system was devised with a centralised architecture based on the client-server model, resulting in ICARO XXI. This system is regarded as a technological innovation. The new design makes it possible to add new technologies, gives the system greater versatility by facilitating change implementation, boosts scalability levels, reduces expansion, operation and maintenance costs, incorporates market standards, and offers greater convergence and integration with SACTA (the Spanish Automatic Air Traffic Control System).

THE NEW SYSTEM has made it easier to capture and add new external clients (airlines, pilots) as all you need to access this tool is a connection to one of the Aena networks and free software packages: JRE 1.5 and Acrobat Reader. The system has also made it easier to upgrade internal users (ARO and NOF operators) and configure user profiles (access permits, visibility). It has the flexibility to adapt to other modes of operation and can be configured based on regional distributions if required by Aena strategy.

ICARO is today an indispensable tool for most Spanish airports, with new connection requests being received every day and the number of web clients and users growing exponentially.

In the late 1980s, Spain's air navigation authorities began modernising their aeronautical information processing systems, replacing obsolete teletypes with a small distributed system with local databases at each site. This initial experience helped consolidate the architecture for a new, more universal system.

ICARO was created in the 1990s to facilitate the automation of aeronautical information management and communications throughout Spain. The ICARO 2000 system was successfully installed between 1994 and 2000. The flight plan and AIS information features were integrated into this version, but meteorological information was not.

ICARO evolved in 1996, adapting to the new procedures and functionality derived from the European IFPS system (Integrated Initial Flight Plan Processing System), which provided a centralised flight plan processing and distribution system for the European countries belonging to EUROCONTROL. Finally, in 2004, progress in web communications and technology made it possible to evolve towards a centralised, comprehensive system: ICARO XXI. ✱

VOLUME OF INFORMATION MANAGED BY ICARO XXI

(Annual figures)

FLIGHT PLANS	1,300,000
NOTAMS	630,000
MESSAGING	
WEATHER	570,000
COMMUNICATIONS	7,600,000
INFORMATION BULLETINS (Pre-flight)	170,000

FEATURES

The ICARO XXI system provides the following services:

>AIS **Manages the information required for operational air navigation safety, regularity and efficiency. The NOTAM office (NOF) is Spain's designated facility for the exchange of notices to air crews which describe temporary situations affecting aeronautical infrastructures (airports, radio aids, radars, etc.). Through ICARO XXI, Aena automates the functions of the NOF, ensuring the suitability, quality and timeliness of the information managed.**

>BOL **In accordance with current regulations, which require aeronautical information to be made available to users, ICARO provides access to such data in the form of pre-flight information bulletins (PIB). These are available on self-briefing terminals installed at airports and through the Aena website.**

>MET **Aviation weather information, prepared by Spain's National Meteorological Agency (AEMET), is received by the ICARO XXI system and made available to the user.**

>GPV **Flight Plan Management. ICARO XXI provides a platform for the initial processing of flight plan messages in which they can be created, distributed and received. User terminals are provided where flight plans can be submitted and consulted. The responsible offices (ARO) manage and monitor flight plans.**

>COM **Enables users to monitor and query all messages received and transmitted by the different components of the ICARO XXI system and the corresponding parties. As a client of the CRAMI system (Automatic Messages Retransmission Integrated Centre), it also allows users to create AFTN messages for distribution.**

>GBDAC **Aeronautical database and configuration management. Facilitates maintenance (addition, removal and modification) of the data required for operation on the system, making it more flexible by allowing changes through configuration rather than version changes. The information processed by this component is subdivided into two types: permanent aeronautical data and configuration data. ICARO XXI is automatically updated with information received from the EAD (European AIS Data Base), comprising updates of the static aeronautical information published worldwide in the AIP. It also manages the configuration and adaptation parameters for the system and each of its components (user profiles, configuration of the COM component, the MET component, etc.).**

>M&C **Monitoring and Control. Ensures proper operation of the rest of the system functions, supervising the system and providing information on its status.**

>BackUP **Performs tape backups and deletes historical data from the system. It also includes a feature for recovering such data.**

Satellite navigation for Europe

Large-scale adoption of the EGNOS system in aviation

Published in itransporte 37

Ineco leads the GIANT-2 project, dedicated to introducing EGNOS satellite navigation into European aviation. The system improves aircraft guidance and makes instrument approaches possible without ground-based radio aids.

In accordance with International Civil Aviation Organisation (ICAO) recommendations and resolutions endorsed in 2007, many European countries are making short-term plans for the implementation of approach procedures with vertical guidance based on satellite navigation, known as APV/SBAS procedures or LPV (Localizer Performance with Vertical Guidance). To this end, the projects financed by the European Commission and EUROCONTROL focus on the large-scale adoption of the European satellite navigation system EGNOS (European Geostationary Navigation Overlay Service) in aviation, by boosting support for the use of these technologies by airlines, end users, air navigation service providers and airports.

The GIANT-2 project "EGNOS Adoption in the Aviation Sector", managed by the GSA (the EU's satellite navigation agency), began in January 2009 for the purpose of introducing satellite navigation into Europe's aviation sector.

GIANT-2 is a continuation of the successful GIANT project, which focused on the regional aviation segment and emergency helicopter operations. This project marked the first time that vertical guidance approaches (LPV) were performed with commercial aircrafts, such as the Dash 8 and Air Nostrum CRJ200, in settings like San Sebastián and Valencia in Spain, and Bologna in Italy. This project falls within the European Union's 7th Framework Programme for Research, Development and Innovation (see Issue 2 of itransporte English Edition).

GIANT-2 has received very positive feedback from pilots, air traffic controllers, equipment manufacturers and operators. The major benefits highlighted during flight tests were greater stability while gliding compared to ILS precision approaches, and smoother, more continuous orientation throughout the flight. They also acknowledged the value of these procedures at airports where the runways are not equipped with ILS instrument landing equipment on the ground, and the fact that familiarisation with this operation does not pose a major problem. Operations based on the EGNOS system are also a very effective instrument for airports, which avoid incurring ground system installation costs.

From the manufacturer's perspective, satellite navigation means achieving greater benefits at very reasonable costs. Although it involves certain modifications to the aircraft, the impact on crew operations is minimal. Similarly, operators agree that it promotes greater operational capacity and, in short, greater optimisation of airport capacity.

The GIANT-2 project complements GIANT in the sense that it addresses three other key market niches, previously identified for LPV approach applications based on the European EGNOS system: business aviation, general aviation and SAR helicopters, with special emphasis on carrying out flight demonstrations in different scenarios in Europe. This is intended to promote the introduction of EGNOS in other market segments. ✱

GIANT-2 CONSORTIUM

To achieve the main project objectives, a consortium was formed with 13 partners from five European countries (Belgium, France, Italy, Spain and the United Kingdom). Some of the members are:

- **Navigation and airport service providers:** AENA.
- **Operators and users:** AIR NOSTRUM, GESTAIR PRIVATE AVIATION, AMERICAN FLYERS.
- **Manufacturers:** DASSAULT AVIATION, AGUSTAWESTLAND, GARMIN AND ROCKWELL COLLINS.
- **Consultancy companies:** INECO, GLOBAL AIR SOLUTIONS, GMV, PILDO LABS AND SPACECONNECT.


AW139 SAR.

Flight tests

Of particular importance to the GIANT-2 project are the in-flight demonstrations and tests of the satellite navigation-based applications. In February 2011, the first flights using precision approaches with vertical guidance (LPV) were performed in Spain. The tests took place at the Cuatro Vientos aerodrome (Madrid) and in Córdoba, aboard a Cessna 172 operated by Gestair Flying Academy (American Flyers). Meanwhile, a simulated sea rescue was performed using an AW139 prototype helicopter near Genoa, on the Italian coast.

Cessna 172.

↑Award for Ineco

In September 2010, the ION GNSS 2010 Conference held in Portland (United States) –considered the most important event in this field–, awarded Ineco the prize for the best presentation in the 'Aviation Applications' Session. Javier Murcia (pictures above), member of Ineco, explained the European operational implementation plans for EGNOS-based LPV procedures, presenting the GIANT-2 R&D+i project led by the company.

Revitalising transport in Costa Rica

Modernising and developing its infrastructures, keys to the future of the country

Published in itransporte 38

A more diversified economy, quality education and political stability are the keystones to prosperity in Costa Rica. The path to growth includes improving the country's transport network, which is why Costa Rica has turned to Ineco.

Costa Rica is the Latin American country with the most tourism (surpassed in the Americas only by the United States, Canada and Barbados) and is enjoying particularly high growth in "ecotourism".

The country's political stability –which has lasted since 1948, a large middle class and the incipient openness of the private sector have favoured the development of the economy. Traditionally based on agriculture, since the late 90s it has evolved towards the manufacture and export of technology products and tourism, which is now the main source of foreign currency and represents 8% of the Gross Domestic Product (GDP).

However, the economic transformations have not run parallel to the development of the country's transport infrastructures. This is why Costa Rica's Ministry of Public Works and Transports (MOPT), with help from Ineco, is drawing up a National Transport Plan that will define its investment programmes until the year 2035 in roads, ports, airports, public transport and railways.

Meanwhile, as part of the National Development Plan 2011-2014, the country has announced an investment of nearly 1.33 trillion colones (almost €2 billion) in 10 strategic transport infrastructure projects, partially financed by the private sector. The Costa Rican government's objective for this period is to maintain an annual investment volume of 2% of the nominal GDP in the transport sector. ✱

analysis

Costa Rica's infraestructures

>ROADS

More than a quarter of the total investment planned will be used to improve the road network. According to the National Transport Plan, the road network, which is vital for domestic connections, reached a total of 40,000 kilometres in 2009, of which nearly 10,000 kilometres are paved. As far as high-capacity roads are concerned, the first toll road was inaugurated in 2010, to be operated as a concession between the cities of San José and Caldera (77 kilometres).

>PORTS

The three main ports are Moín and Limón on the Caribbean coast, and Caldera on the Pacific coast. According to MOPT figures, these ports mobilised 12.1 million tons of cargo in 2009 (98,3% of the national total). The actions planned include the construction of a new container terminal and a petrochemical terminal at Moín and a grain terminal in Caldera, while Limón is expected to receive a greater number of large tourist cruises.

>AIRPORTS

Costa Rica has four international airports, as well as 116 aerodromes and 7 heliports. In the centre are Juan Santamaría Airport in Alajuela (17 kilometres from the capital, San José) and Tobías Bolaños Airport in the town of Pavas. Daniel Oduber Airport is located in Liberia, in the tourist area of the northwestern Guanacaste province. Puerto Limón Airport is on the Caribbean coast. Roughly 70% of visitors to the country arrive by air.

>RAILWAYS

The railway network dates back to the late 19th century, and only some lines are currently operational. They serve passengers in the area of San José and freight in Moín. In the short term, the government's National Development Plan 2011-2014 has planned two actions affecting the railways: the renovation of two unused sections (Heredia–Alajuela, 12 kilometres long, and Cartago–San José, 23 kilometres), for which it has allocated 20 billion colones.

solutions

Ineco's participation

>NATIONAL TRANSPORT PLAN

(Costa Rica's Ministry of Public Works and Transports). Initiated in 2010, this is a comprehensive study encompassing all modes of transport in the short, middle and long terms, with the year 2035 as its time horizon. It aims to provide the Costa Rican government with a set of programmes and strategic actions to be undertaken over the next 25 years, prioritised by mode of transport, and to propose possible sources of funding. The MOPT highlights the importance of this study, 'particularly for the road network, where no plan of this magnitude had been undertaken since 1977', its intermodal focus, and its relevance 'for responding to the country's strategic economic goals', such as tourism and 'foreign investment in industrial and business projects', without losing sight of 'the economic sustainability of such investment'.

>COMPREHENSIVE AIRPORT MODERNISATION PLAN

(ICAO – Costa Rica's Directorate General of Civil Aviation). Developed during 2010, its objectives are to identify and evaluate modernisation and possible expansion needs, redefine possible specialisation strategies (passengers, cargo, tourism, general aviation), study private sector participation formulas and provide a planning tool.

>TECHNICAL ASSISTANCE FOR THE CURRENT AND FUTURE DEVELOPMENT OF THE NATIONAL RAILWAY NETWORK

(INCOFER, Costa Rican Railway Institute). Undertaken in 2009, in a joint venture with the Spanish company Iberinsa, this includes analysis and diagnostics of the state of the infrastructure and rolling stock in the Pacific railway corridor (San José–Puntarenas, 157 kilometres) and the Atlantic railway corridor (San José–La Junta, 102 kilometres, and Río Frío–Limón–La Estrella, 171 kilometres).

'Roads are the mode of transport demanding the most attention'

María Lorena López Rosales

Vice Minister for Infrastructure, Ministry of Public Works and Transport of Costa Rica (MOPT)

Costa Rica's economic growth has surpassed that of its transport infrastructures, and the government is now taking steps to reverse that trend.

Would you give us an overview of Costa Rica's transport infrastructures?
Overall, they represent a huge challenge for our country. Due to different restrictive economic and fiscal situations, the roads have been lagging behind over the past 20 years, in sharp contrast to the considerable growth that Costa Rica has experienced in tourism and the economy in its recent history. Our infrastructures have not responded adequately to growth and we calculate that we suffer from an approximate deficit of $15 billion (about €11.3 billion) in this area.

What type of traffic do you plan to promote the most? Which one demands the most attention?
Roads are the mode of transport demanding the most attention. Costa Rica is a small country, with only two large international airports handling regular flights, through which nearly two million passengers arrive annually. We have one major port in the Caribbean and another on the Pacific coast. We are considered one of the most prosperous countries in Latin America, after Uruguay and Chile, which means that the mobility of trade and persons continuously demands higher quality and efficiency.

What role does Costa Rica's transport network play with regard to sectors such as the manufacture and export of technology products and materials, and in tourism?
The transport network is vital. As a country, we have focused on exports and services, and have promoted tourism as our main source of resources. In this sense, our economy is highly dependent on road transport. The railways do not offer greater opportunities for growth in the short term.

What role does private initiative play in the development and financing of public works?
Private initiative must play a very important role in the development of our infrastructures. A container terminal is currently going through the concession process in our Caribbean port. Our other port has a grain terminal operating as a concession. There is private participation at our two large international airports. The same is true of our roads. The system must be strengthened institutionally to achieve greater levels of successful participation.

In this sense, what model is the government adopting?
For the most ambitious projects, we are basically adopting public works concessions and shared management as models requiring private initiative participation. Costa Rica is a world leader in the area of environmental protection policy.

How do you plan to reconcile this with the development of transport infrastructures?
Infrastructures and the environment must coexist respectfully. Environmental studies will be increasingly rigorous and the mitigation measures associated with environmental impacts must be respected. The high vulnerabilities associated with the natural disasters that occur in an area with mountainous terrain and a rainy climate must be taken into account. This is precisely one of the greatest challenges for achieving a sustainable road system.

What peculiarities must be considered when planning railway transports in Costa Rica?
The network will focus on two areas: interurban transport and high-volume freight transport. In the Caribbean region, there are already branch lines in operation for transporting bananas, while the grain sector is an important railway client on the Pacific coast. As far as interurban transport is concerned, Costa Ricans have high expectations of acquiring a modern system, complementary to the bus network, which currently serves more than a million passengers in the metropolitan area. ✱

'Our economy is highly dependent on road transport. The railways do not offer greater opportunities for growth in the short term'

bio

María Lorena López Rosales has 30 years of experience in the field of transport, particularly in planning and concessions. She holds a degree in Civil Engineering from the University of Costa Rica and a Master of Science in Transportation Engineering from George Washington University (United States). She taught at the College of Civil Engineering at the University of Costa Rica for 10 years, and served as Vice President of the National Viability Council and Vice Minister for Public Works from 2002 to 2006. She has held her current position since May 2010.

priorities

State of the roads

López Rosales explains that Costa Rica's road network is roughly 40,000 kilometres long, of which 7,500 kilometres are classified as national roads and are the responsibility of the central government. The municipalities are responsible for the rest. 'The network is dilapidated and only 30% is in good condition', she explains. 'The rest of the network is in use, but with an excess of patches, structural damage, geotechnical problems, bridges requiring renovation and bad road signs. Our priority is total road conservation'.

The driving force of new times

Ineco leads four international R&D+i consortia

Published in itransporte 41

Ineco invested nearly €5 million in innovation in 2010. This represents 1.5% of its sales volume, compared to the average 1.1% that Spanish companies invest in innovation.

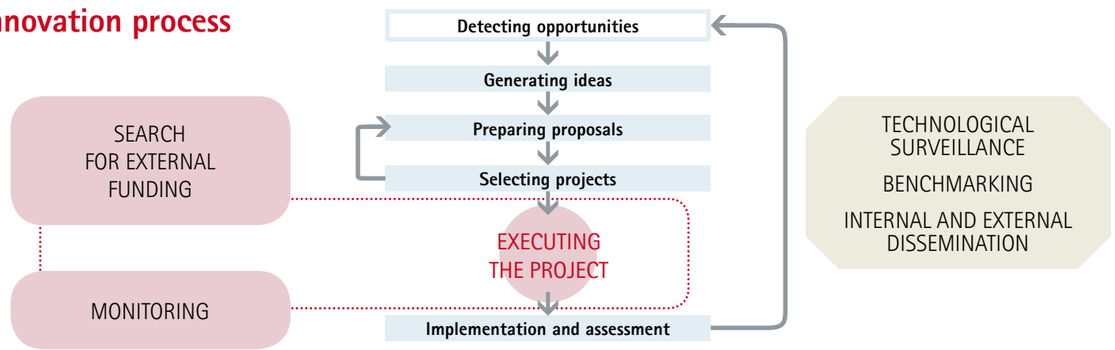
Thanks to the efforts devoted to innovation, the new economic and technological challenges in the transport sector have been incorporated into the services offered by Ineco, helping the company to maintain its position among Spain's leading transport engineering and consultancy firms. With this investment, Ineco intends to meet its commitments to society and its partners and clients, and to increase its productivity and competitiveness by developing new products and services requiring constant improvements in efficiency and effectiveness.

To offer effective, affordable solutions as soon as possible, with a more ambitious time frame and geographical scope, it is necessary to redefine the framework in which the company's research, development and innovation take place. Ineco's R&D+i policy responds to this need for a new approach, aimed at monitoring, organising, planning and orienting the company's innovation efforts in an integrated manner and adapting them to future market demands and needs, in close collaboration with production areas, in search of the added value that has always characterised the company. Through its new R&D+i policy, Ineco intends to align its increasing competitiveness with the actual needs of today and the future.

By following the recommendations in the Spanish COTEC (the business supported institution with a view to contributing to the promotion of technological innovation) reference framework, Ineco has designed its policy with a structure intended to guide, support and effectively follow the progress of innovation in the company, with special attention to the development of the projects themselves.

Ineco's interest in and dedication to R&D+i projects is reflected in its participation in 38 nationally and internationally funded projects (see page 72) and 12 international R&D+i consortia, four of which are being led by Ineco: Giant 2, TITAN, GRAIL 2 and ACCEPTA. ✱

Innovation process



Ineco's activities for supporting and promoting a culture of innovation focus on driving the need for innovation and the associated benefits, and disseminating innovative and innovation-related activities. A chain reaction is produced, based on the dynamisation of previously identified entrepreneurs, so that reinforcement, support and constant communication through different media motivate new personnel to participate in the defined innovation process. Dynamisation activities are geared towards reactivating the company's entire team in order to spark an interest in innovation.

INTERNAL PROJECTS COMPLETED IN 2010

ARQOS
ANALYSIS OF NETWORKS IN RAILWAY SYSTEMS
A unique service for monitoring and validating mobile GSM-R communications on both high-speed and conventional lines. It incorporates technological advances aimed at detecting, identifying and improving the maintenance programme and design of these communications networks.

E-PLAN
AIRPORT PLANNING AND ANALYSIS
Provides a service capable of improving the traditional management process for airport capacity planning with less investment in analysis time and increased quality.

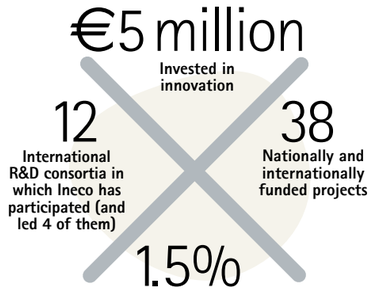
SIOS3
Development of new modules for the successful SIOS system. These are geared towards future applications for controlling the operation and maintenance of railway infrastructures, and cover a wide range of areas within the same easily accessible and traceable application. SIOS Inventory has also been created, an expanded service covering activities associated with the platform, tracks, power installations, safety and signalling, etc.

HELIOS
Studies airport environments, identifying aspects that could affect the safety of operations. Facilitates the planning process for expansions and new airport infrastructure from an early stage of the design process.

IMPULSE
A software application that automates analysis of the possible impact of large obstacles on the behaviour of navigation and surveillance systems using pulsed signals. This software incorporates Ineco's own novel methodology, aimed at improving the quality of CNS system consultancy services.

SAD
Basis for creating intelligent software dedicated to real-time incident management. Favours decision-making, promotes safety and service quality and increases end-client satisfaction.

Promoting innovation



Percentage of investment compared to sales volume
(1.1% is the average for Spanish companies)

EUROPEAN AND INTERNATIONAL INITIATIVES

Ineco has participated in European and international initiatives as part of the European Union's 7th Framework Programme. The company's participation in 12 consortia has helped it to establish itself as a key player on the European market. Ineco has also participated in different R&D+i platforms: the European aeronautical platform (EATRADA), the Spanish rail transport platform (PTFE) and the Spanish road technology platform (PTC), which it joined in 2010.
(See page 72 for more information).

The 2010 R&D+i agenda

Participation in 38 nationally and internationally funded projects

Commitment

Published in itransporte 41

SELF-FUNDED

ACDA_Viability study for the development of advanced CDAS procedures.
CRM_Development of a CRM solution and pilot implementation at Ineco's Development and International Affairs.
DETEC_Development of online track instrumentation techniques.
HEPA_Development of a tool for studying electrical power at airports.
PEIF_Development of a tool for railway installation operation programmes.
PILAS_Study of erosive capacity around piers using two-dimensional river modelling techniques.
SOFTDIS_Development of support software for the design of railway safety installations.
SSICT_Development of solutions for improving critical transport infrastructure safety (with a focus on railways).
ARQOS_Analysis of the service quality parameters of GSM-R mobile communications networks to determine the correct planning process for the network and its services.
CLIMA_Viability study for solar climate control systems at airport facilities.
E-PLAN AIRPORT_Development of an airport planning and analysis tool.
IMPULSE_Development of an application for analysing problems with navigation systems. Pulsed signal simulator.
PHOTOVOLTAIC PLATFORM _Implementation of a photovoltaic power plant for Ineco headquarters on Paseo de la Habana (Madrid).
SIOS3_Development of an information and comprehensive management system for underground works.

NATIONALLY FUNDED

MAT_Design of an architectural transit module for passengers in places related to means of transport: Community of Madrid.
NAZPLV_Development of a computer application for the generation of flight plans at airports in the Aena (Spanish Airports and Air Navigation) network: Community of Madrid.
RWY-EX_Development of an aircraft runway operation simulator for safety evaluations: Community of Madrid.
SAD_Development of a decision support system for incident management in the railway sector: Community of Madrid.
ACROR_Development of an aircraft behaviour analyser based on RADAR data: CDTI (Centre for Industrial Technological Development).
CRONOS 2.0_Development of a comprehensive analysis solution for railway line operation: CDTI.
HECCO_Development of a communication coverage evaluation tool: CDTI.
TUNNEL_Study of the aerodynamic effects of high speeds on long tunnels and definition of special measures to be taken to dissipate overpressures: CDTI.
HELIOS_Calculation and evaluation of aeronautical easements: CDTI.
A-320 SIMULATOR_Flight simulator for engineering: CDTI.
VULCANO_Development of a methodology for fire prevention and risk evaluation around electrical and railway lines: Ministry of the Environment and Rural and Marine Affairs (MERMA).
HARMONICS_Study of the harmonic interferences generated by rolling stock: Spanish R&D+i Plan, Ministry of Science and Innovation (MSI).
EUROLINK_Advanced railway interoperability systems based on ICT technologies through the development of ERTMS components: Spanish R&D+i Plan, MSI.
TICLOG_Communications technologies for improving information and safety along the logistics chain: Spanish R&D+i Plan, MSI.

INTERNATIONALLY FUNDED [7th European Union Framework Programme]

AAS_Integrated airport apron safety fleet management.
ACCEPTA_Accelerating Egnos adoption in aviation.
DEMASST_Demo for mass transportation security. Road-mapping study.
EPISODE-3_Single European Sky Implementation support through Validation.
GIANT-2_Egnos adoption in the aviation sector.
GRAIL-2_GNSS introduction in the rail sector 2.
INESS_Integrated European signaling system RESET. Reduced separation minima.
STANDARDS_Standardization and reference documentation support. Standards.
SUGAST_Support to Galileo standardization.
TITAN_Turnaround integration in trajectory and network.
TRIOTRAIN_Total regulatory acceptance for the interoperable network.

Mankind and water

Minimizing the impact on groundwater during the execution of underground works

Published in itransporte 36

Human intervention affects groundwater, and vice-versa: hydrogeological studies, such as those performed by Ineco specialists, serve to prevent problems during works and to ensure the least possible impact on groundwater.

Water represents one of the main problems when undertaking underground works. The hydrogeological environment is dynamic. It maintains a delicate balance with the other elements in the water cycle, from the precipitation feeding the aquifers to the bodies of water on the surface, which provide outlets for groundwater.

When underground works take place under the water table, a disturbing element is introduced into the hydrogeological system, altering its balance. The hydrogeological environment will react to reestablish balance, integrating the underground works into the system as a new element. The impact of human groundwater uses also determines the possible socioeconomic impact of a particular project. ✱

Effects of underground works

Generally speaking, two possible effects on the hydrogeological environment can be considered when introducing an anthropic underground element, depending on whether it impedes the flow of water (impermeable) or not (permeable). If it is impermeable, this constitutes an obstacle to underground water flow with respect to the natural regime, resulting in a "barrier effect". The intensity of this effect will depend on the shape of the construction, its orientation with regard to the flow, and whether or not it crosses the entire thickness of the aquifer. In this sense, the most unfavourable case would be an element with an elongated geometry, arranged perpendicularly and completely crossing the aquifer formation.

If, on the contrary, the man-made element allows underground water to flow through, it will become an additional drain in the aquifer system, which will react by adapting to it. In this case, a large influx of water can be expected inside the element.

As far as the effects on the aquifer environment are concerned, a drop in water table levels can cause effects ranging from the drying up of springs to disconnection from the hydrographic network, or from any other body of water on the surface. In this last case, the underground flow of water towards these bodies of water would be inverted. Rather than receiving water from the aquifer, they would lose water to the aquifer themselves. In extreme cases, this could cause surface waterways to dry up, or result in seawater intrusion.

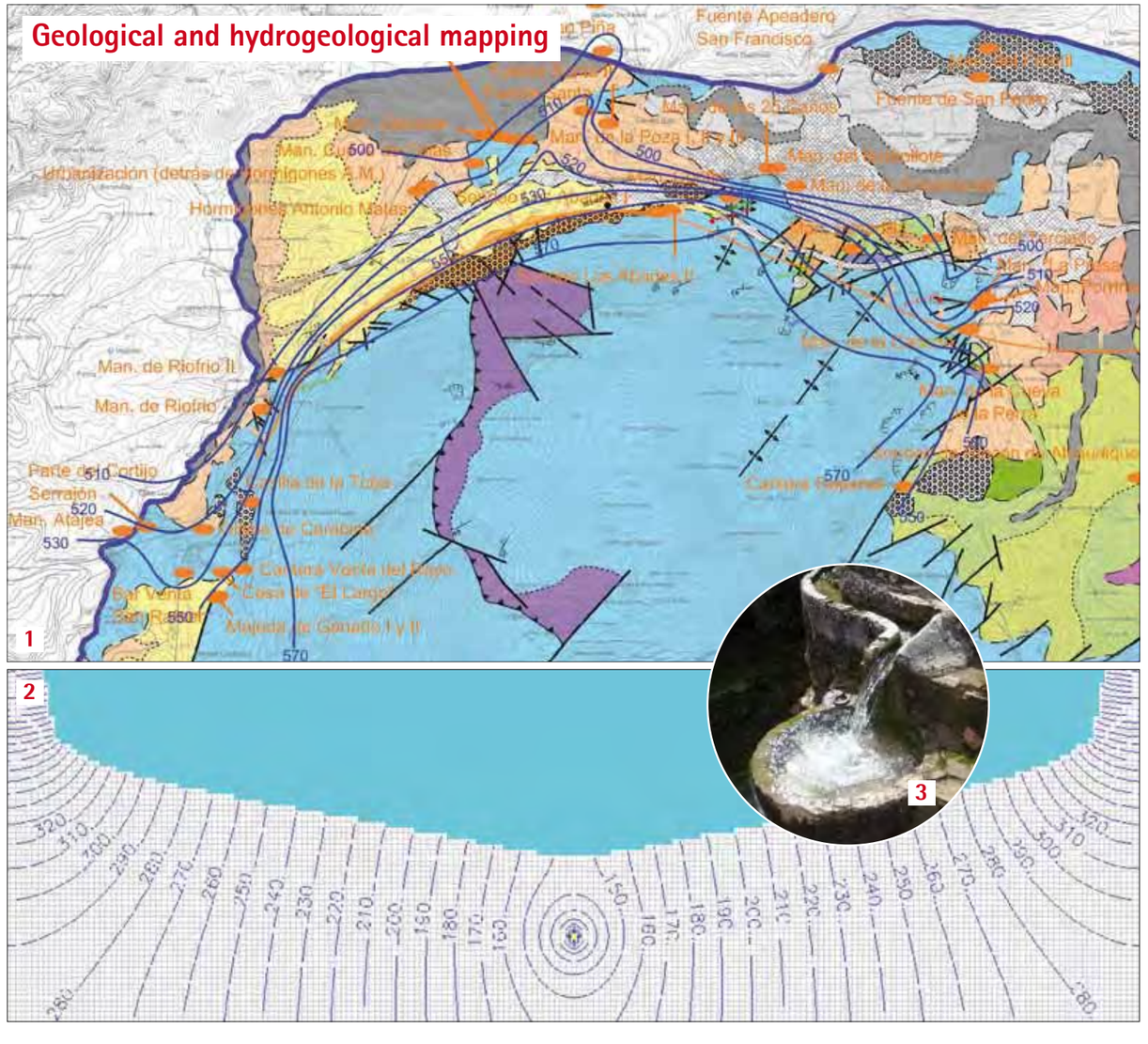
OPPOSITE PAGE: [1] Construction of the ground water contours in the discharge area for the Sierra Gorda aquifer (Granada), towards the Genil River. For this purpose, data collected during a previous water point inventory was used. [2] Model of the drainage effect caused by the Pajares Tunnels (Asturias–León). [3] Detail of Fuente Alta spring, in the town of El Salar (Granada), included in the hydrogeological study of the Loja bypass of the high-speed railway line Bobadilla–Granada.

Ineco's Hydrogeology team

Ineco has a hydrogeological team specialising in the study of the interaction between large underground works and the aquifer environment. The team is comprised of personnel with scientific and technical training, mainly geologists specialising in different areas within the field of hydrogeology, in addition to technical engineers and topographers. They occasionally receive assistance and cooperation from notable external entities, such as the universities of Oviedo, A Coruña and Almería.

The team's origins date back to 2006, when the Pajares Tunnels (Asturias–León) were drilled: Ineco was asked to conduct the 'Hydrogeological study of the area surrounding the Pajares Tunnels'. Since then, the company has undertaken other projects in different areas of Spain. This has led to the development of Ineco's own methodology, which is flexible and based on direct observation and field data.

RIGHT: An assessment inside one of the Pajares Tunnels to monitor the flows drained from each aquifer system crossed.



Ineco has a hydrogeological team specialising in the study of the interaction between large underground works and the aquifer environment.

How a hydrogeological study is conducted

1 The first step is a **review of the existing information**, which provides an idea of the geological and hydrogeological circumstances of the area, the existing aquifers, types of aquifers, nature of the aquifers and the general functioning of the underground water flow in the area. In some cases, specific information can be found on recharge and drainage figures, quantification of hydrogeological parameters, water table level or phoronomic monitoring, etc. An overview of the area is often available, but without details. In this sense, information from previous geotechnical campaigns is fundamental, including data logging and permeability tests (Lefranc or Lugeon).

2 One of the first tasks to be undertaken next is a **geological and hydrogeological mapping**, with the degree of detail required by the study in question. This makes it possible to accurately define the affected aquifers. Once identified, aquifers are the basic units of analysis within each study. Thus, a particular study might consist of a single large aquifer with considerable water resources, or a set of more or less numerous aquifers, some with hydraulic connections to each other, that can be taken as a single unit (aquifer system).

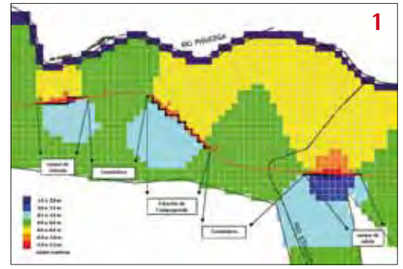
3 At this point, each of the elements comprising the differentiated aquifers must be identified. For this purpose, a **water point inventory** is performed, including any element or structure that represents a direct "contact" with the aquifer. Thus, wells, soundings and springs provide direct observation points for monitoring the water table level. Just as important as the spatial distribution of these points is the study of variations in the water table level over time, at least during a hydrological year. This is crucial for determining whether or not underground works will interact with the aquifer environment.

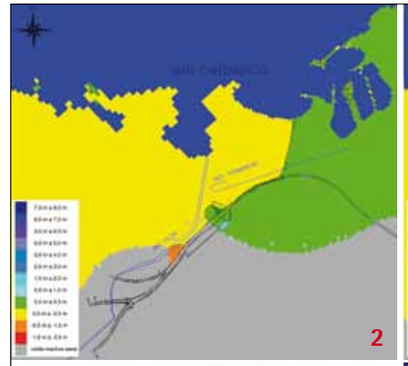
>**Field campaigns** are often conducted, in which piezometers are constructed and equipped at strategic sites in the area. The data from the piezometers make it possible to reconstruct the underwater flow. It is also common to construct pumping groups and perform tests under controlled contour conditions in order to find the hydrogeological parameters of the aquifer environment. Special care is taken to isolate the aquifer level studied in each case within the piezometers and pumping wells, which is not usually considered in merely geotechnical campaigns.

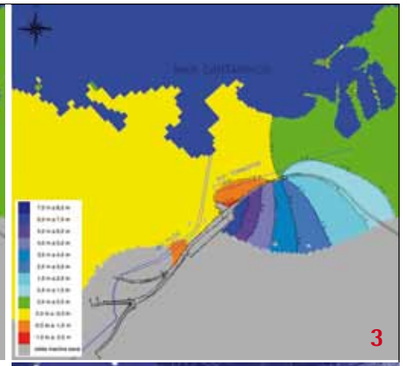
>The selection of different points that will become a **Hydrogeological Monitoring and Control Network** and periodic data collection make it possible to analyse the evolution of the aquifer. When this is done in the natural flow regime, the results obtained correspond to the more or less seasonal variations. When performed concurrently with or following underground works, the results reflect changes in the effects on the aquifer environment.

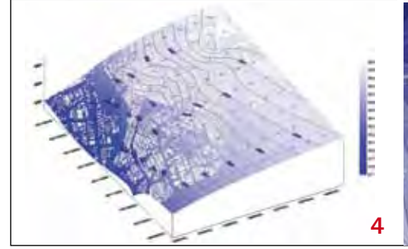
>The use of **continuous recording instrumentation** plays an important role in this work. In this case, there are specific sensors to record the water surface level, designed for installation inside wells and piezometers, for continuous monitoring of the water table level. It is also possible to record detailed information on precipitation in different areas of the aquifer. The study of precipitation and temperature is fundamental for establishing the area's hydrometeorological budget and quantifying recharge for different periods (the summer months, rainy periods, etc.).

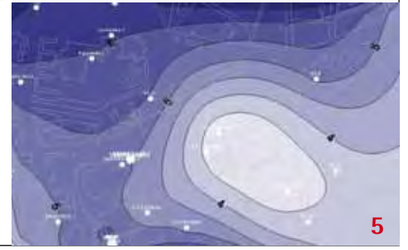
4 The last stage of the study is **mathematical modelling**. This is a complex process, in which it is fundamental to establish the contour conditions using geological and hydrogeological criteria, and to calibrate the model, an iterative process that continues until the model accurately reproduces the water table level and flow variations actually observed. The model makes it possible to predict the interaction of the works with the aquifer medium, and to plan corrective measures if necessary.











[1] 'Barrier effect' produced by the underground high-speed railway tunnel in urban areas (Valladolid). [2 and 3] Simulation of the 'barrier effect' on the underground water flow (Gijón). [4] Piezometric surface (Valladolid). [5] Depth of the water table level around Valladolid station.

Interaction between tunnels and water: some experiences

>PAJARES TUNNELS

Ineco now monitors the hydrogeological control and surveillance network established during the study, which has made it possible to analyse the spatio-temporal behaviour of the interaction between the Pajares Tunnels and the hydrogeological environment. This project complements the aforementioned 'Hydrogeological study of the area surrounding the Pajares Tunnels'. Both have played an essential role in determining the corrective measures for minimising the influence of the drainage caused by the tunnels, and planning and budgeting for such measures. Hydrogeological monitoring will continue after the tunnels are completed in order to analyse and determine the effectiveness of these corrective measures over the short and medium term.

>HIGH-SPEED TUNNELS

Such as the one in Archidona (Málaga) and the Loja bypass at its passage through Sierra Gorda (Granada). The importance of this last case (see picture 1 on page 75) lies in the fact that the hydrogeological study and monitoring began concurrently with the informative study for the project. This was an unmissable opportunity to characterise the aquifer and analyse its behaviour in the natural flow regime before starting the works. Moreover, due to the special climatic conditions observed during the winter of 2009-2010, with an unusual abundance of precipitation, the area could be characterised in a 'high water' scenario (maximum water table levels). This was of particular interest for planning corrective measures to be on the safe side.

>STUDIES FOR UNDERGROUND RAILWAY LINES IN URBAN AREAS

Such as those in the cities of Valladolid, Gijón and Logroño. In these cases, there was an additional problem: the flow in the initial scenario was already highly altered by the existence of a considerable number of underground anthropic elements, such as basements, parking garages, underpasses, preexisting tunnels, etc. The effects of the introduction of a new element and its influence on existing elements are nearly impossible to analyse without constructing mathematical models.

■ In Valladolid, the route for the new high-speed railway tunnel, with underground tracks, ran more or less parallel to the river. It therefore represented a nearly perpendicular barrier to the underground water flow. The hydrogeological study made it possible to later calibrate a mathematical model simulating the effectiveness of different solutions for restoring the flow of water and avoiding effects on existing constructions.

■ In Gijón, a city by the Cantabrian Sea (north of Spain), a study addressed the interaction between the planned intermodal station and the aquifer environment, comprised of Jurassic calcareous materials forming a multilayer aquifer. Although the mathematical modelling was arduous, it was successfully concluded. In this case, there was a risk of marine intrusion phenomena aggravated by the influence of the ocean tides. This influence extends several hundred metres inland, as shown in the study (see pictures 2 and 3 above).

Rules for a good neighbourhood

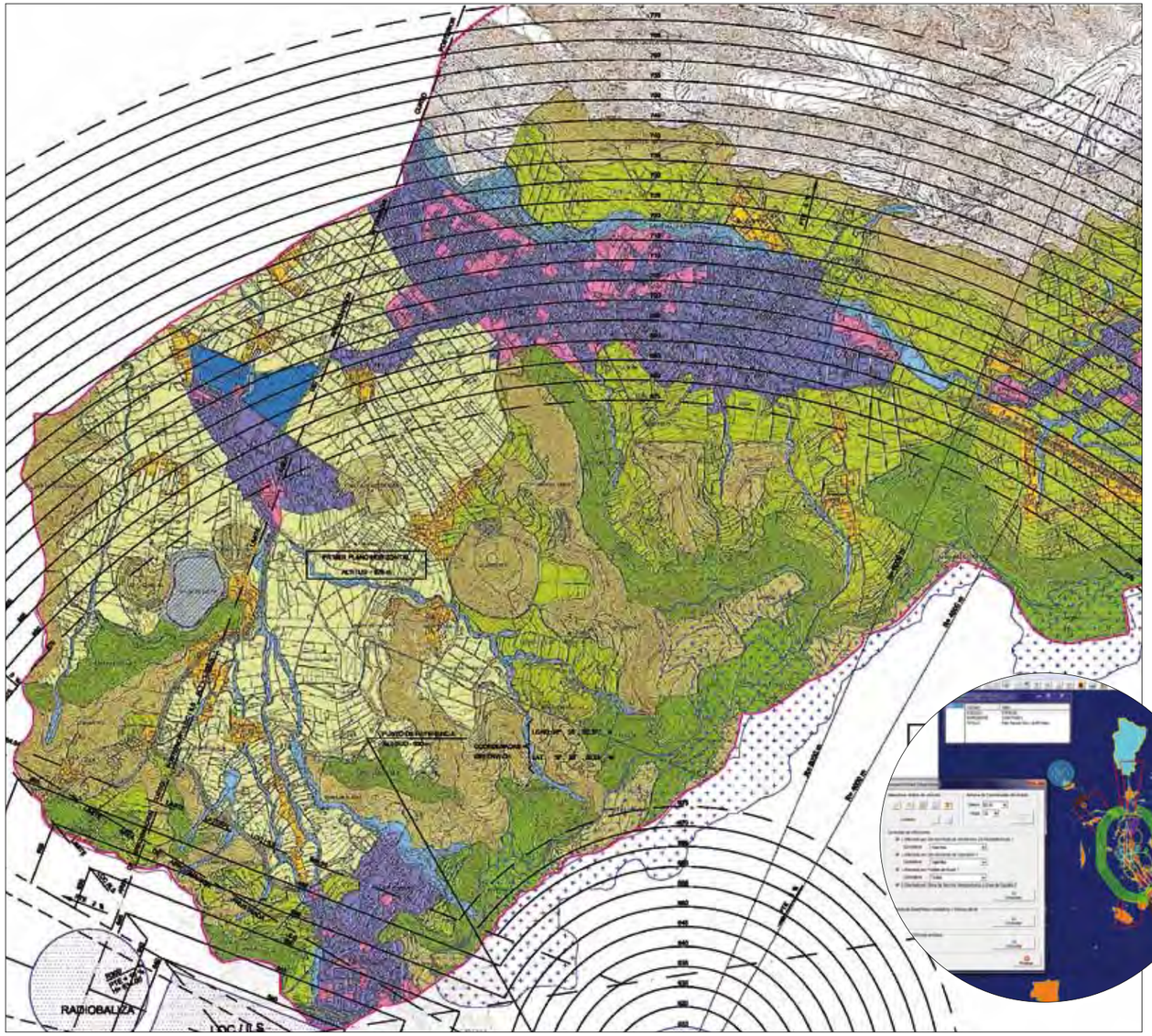
Ineco applies its extensive experience

Published in itransporte 41

Airport activities affect those of the surrounding environment, and vice-versa. The purpose of aeronautical easements is to ensure compatibility between the two. Ineco has extensive experience with such easements and has conducted its own R&D+i in this area.

An airport is an important focus of economic activity. The immediate vicinity is therefore very attractive for different business activities, and this affects urban development. At the same time, airport activities affect the quality of life of the inhabitants of nearby towns, particularly their acoustic comfort.

Different types of easements are established by legislation, which defines different types of restrictions. The ultimate goal is to ensure that the airport's operational safety is compatible with the activities in the surrounding area, including urban development. *



TYPES OF EASEMENTS

The purpose of aerodrome easements is to guarantee the safety of aircraft movements at aerodromes and in the surrounding areas. Radioelectric installation easements ensure the correct equipment operation, and aircraft operation easements guarantee the different phases of instrument approach manoeuvres . Finally, acoustic easements are intended to make urban planning in the surrounding area compatible with aeronautical activities.

RESTRICTIONS WHICH GUARANTEE SAFETY

An area free of obstacles

Around 15% of Spain's municipalities are affected by aeronautical easements. Ineco has been helping Aena develop such easements for years using its own tools.

Obstacle limitation in the vicinity of airports, essential to guaranteeing operational safety, involves the public administrations (national, regional and local), the surrounding towns, land owners and the airport managers themselves. Uncontrolled building next to airports can not only decrease their efficiency in terms of capacity, but can even impede certain operations.

Spanish aeronautical regulations therefore define a series of surfaces in the vicinity of airports that must be kept free of obstacles. These surfaces mark the height limits for nearby constructions and installations within the airspace. Spain's aeronautical regulations already take these surfaces into account. With guidance from the International Civil Aviation Organisation (ICAO) and in accordance with the rules at the time, Spanish Decree 584, dated February 24, 1972, they defined the aeronautical easements, areas and surfaces to be established in and around aerodromes. This easement decree is now being updated, largely due to the discrepancies between those regulations and the standards and recommendations proposed by the ICAO. Moreover, Spanish Royal Decree 862, dated May 14, 2009, which approved the technical standards for the design and operation of public aerodromes and regulating the certification of airports by the State, defined obstacle limitation surfaces in a slightly different way to those established in Decree 584/1972. Modification of the Decree will bring the proposed legal protection marked by aeronautical easements in line with today's airport operations.

Urban integration studies. Within this legal framework, Ineco is conducting different studies in order to make airports ➔

Helios, an innovation tool

The areas affected by aeronautical easements established for the airports managed by Aena occupy over 1.8 million hectares of Spanish territory. Spain has 8,116 municipalities, of which roughly 1,200 (around 15%) are affected to some extent by the aeronautical easements defined for these airports.

In order to handle this amount of data, Ineco has developed HELIOS, a tool based on a Geographic Information System (GIS), to which a series of specialised tools have been added to calculate obstacle limitation surfaces and territorial integration studies. It also includes an extensive urban planning database. Its two-dimensional query tools evaluate whether a particular territorial area is affected by the airport and to what extent, and whether a specific area or installation is within the airport service area. They also use the approved isophonic curves to determine the noise level in a certain area. The three-dimensional tools evaluate the impact of the height limitation surfaces on the territory and can even calculate them if they are not available in the database.

Spanish aeronautical regulations define a series of surfaces in the vicinity of airports that must be kept free of obstacles.

→ compatible and harmonious with their surrounding areas. In particular, the company has been working for over 10 years for Spain's aeronautical authorities, reviewing and studying the projects for urban and territorial development plans and instruments that the public administrations must send to the Spanish Ministry of Development prior to initial approval. The studies analyse whether the projects respect the easements and whether the land uses proposed are compatible with the noise levels.

Project in Oman

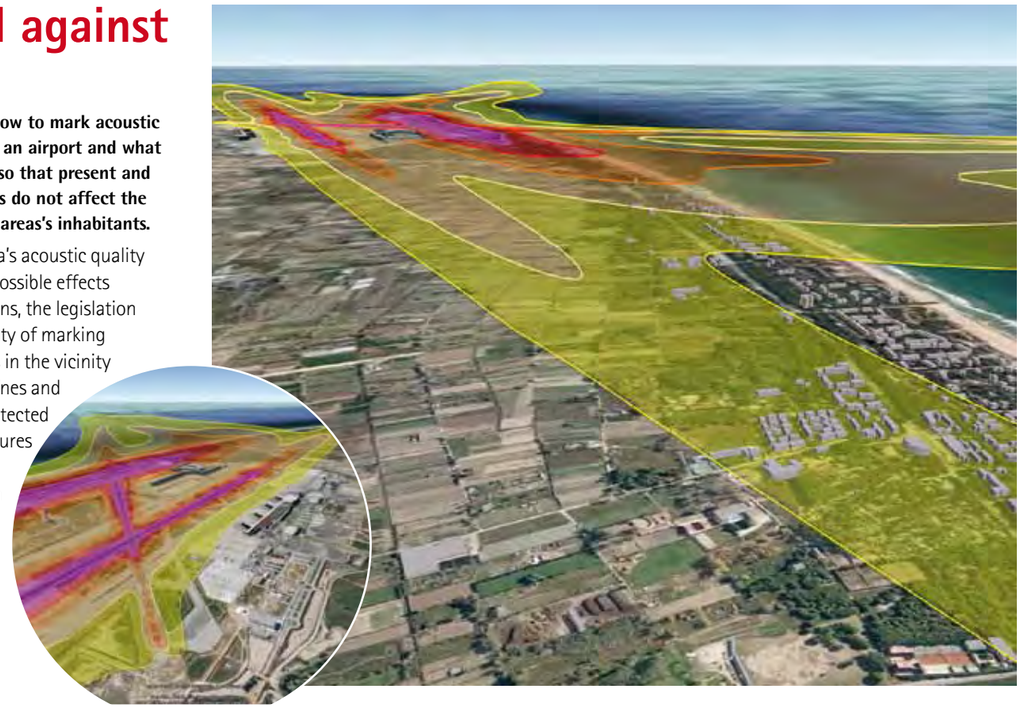
The experience acquired with HELIOS is proving extremely useful for defining similar tools for international clients. This is the case of the project now being conducted for the Omani government. The GIS-based tool under development has been adapted to the country's legislation and takes into account obstacle limitation surfaces, the noise footprints present in the airport Master Plans, protection surfaces for radioelectric aeronautical installations, special wildlife protection areas and Public Safety Zones (PSZ), among other elements.

ACOUSTIC EASEMENTS

Protected against noise

The legislation defines how to mark acoustic protection areas around an airport and what measures to implement so that present and future airport operations do not affect the acoustic comfort of the areas's inhabitants.

To preserve an area's acoustic quality and palliate the possible effects of noise immissions, the legislation provides for the possibility of marking acoustic easement areas in the vicinity of ports, roads, railway lines and airports. This creates protected areas around infrastructures that take into account the future urban growth of the municipalities, making it necessary to correct all existing acoustic conflicts deriving from such operations by means of a plan of action.



Measures for acoustic comfort

>REPERCUSSIONS ON URBAN PLANNING

■ **Land management is one of the most effective means of ensuring compatibility between the activities in the surrounding area and airport operation and development. Proper planning optimises the effectiveness of protective and corrective measures, such as technical improvements to aircraft and operational abatement procedures.**

■ **Acoustic easement areas establish a stable corridor in which certain land uses, activities, installations and buildings are restricted under Spanish legislation, thus avoiding future conflicts.**

■ **The territory was previously divided into acoustic areas or sectors based on the predominant land use. This competence corresponds to the different regional administrations (Spanish autonomous communities) and is usually delegated to the municipalities. Before approving any urban development plan, they must receive a binding report from the national administration (Civil Aviation Authority of the Spanish Ministry of Development).**

>ACTION PLANS

■ **What happens when acoustic easements affect previously developed urban areas? For these cases, the legislation requires that mandatory 'action plans' be drawn up. They must contain at least the following: the legal context, a description of the infrastructure and quantification of the acoustic effects generated, a definition of the current measures implemented, and a short- and long-term action programme to correct any conflicts detected.**

■ **The actions undertaken by Aena in terms of corrective acoustic measures fall under the 'balanced approach' concept introduced by the ICAO in the late 90s to address the problem of airport noise. The ICAO has established four areas of action: reduction of noise levels at the source, suitable land-use planning and management, establishing noise abatement operational procedures and adopting operating restrictions.**

The 'balanced approach' concept also recommends that several measures be considered simultaneously.

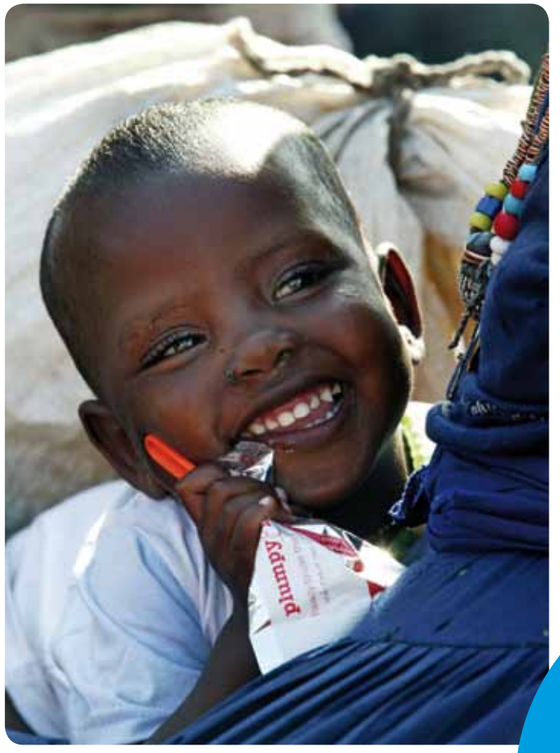
■ **Other complementary measures have also been defined, such as acoustic insulation in homes (which Aena has been implementing for over a decade) and instruments of political participation that make it possible for the parties involved to intervene in the process in order to achieve greater transparency and to generate confidence in all measures undertaken.**

Process of calculating noise immission levels

Aena is in charge of defining acoustic easement areas. The process starts with the creation of a noise map, in accordance with the technical specifications established by current regulations. Later, the Spanish Ministry of Development, through the Civil Aviation Authority, must give its approval and publish it in a Ministerial Order.
The acoustic evaluation is performed by calculating the immission levels for certain indicators reflecting the long-term average noise level at different times of day, divided into periods. Different physical and operational scenarios are also considered in order to depict the actual situation, as well as the expected development scenarios contained in the Master Plan for the airport.
In Spain, there is no nationally accepted standard noise calculation methodology. The methodology used as a reference is established in Document 29 of the European Civil Aviation Conference ("Report on Standard Method of Computing Noise Contours around Civil Airports"), published in 1997. For evaluating noise indicators, the modelling software used by the US Federal Aviation Administration (FAA) is used: the INM (Integrated Noise Model), which incorporates the variables defining the location and sound immission power, as well as the sound propagation generated.

The results produced by this process are isophonic curves, or curves showing similar noise levels. These lines mark the territory included in the aeronautical easement area. The isophonic curve, or noise index level curve, farthest from the airport infrastructure for the scenarios studied is the outer boundary for the area, according to the immission limit values set for the land use type, specifically for residential use. The validity of this boundary is indefinite as long as no changes in the airport infrastructure alter the noise levels in the surrounding area. In this case, a review would be required.

NEW CORPORATE SOCIAL RESPONSIBILITY (CSR) CAMPAIGN



PHOTOS BY MÉDECINS SANS FRONTIÈRES (MSF)

Each individual package of 'Ready to Use Therapeutic Food' (RUTF) contains 500 calories.

INECO'S DONATION TARGETS THE NUTRITIONAL PROGRAMME, BUT THE OVERALL OBJECTIVE OF THE CAMPAIGN IS TO PROVIDE HUMANITARIAN MEDICAL ASSISTANCE TO THE POPULATION. OVER THE COURSE OF THIS PROJECT, CONSIDERABLE TARGETS HAVE BEEN REACHED, SUCH AS INCREASING THE NUMBER OF MOBILE CLINICS AND TRAINING COMMUNITY HEALTH WORKERS TO DETECT POSSIBLE CRISES THAT COULD WORSEN THE SITUATION FOR THE POPULATION.

Ineco against hunger

Over 1,000 children in Degehbur (Ethiopia) have received therapeutic nutritional treatment thanks to donations from Ineco employees who participated in the 'Euro Solidario' campaign, in collaboration with Médecins Sans Frontières. The next project chosen will target child malnutrition in Darbhanga (India).

Ineco has increased in recent years its participation in Corporate Social Responsibility (CSR) campaigns in an effort to reconcile business management with social, labour and environmental concerns in a balanced manner.

One representative action is the *Euro Solidario* project, in which company employees can participate by donating €1, or as much as they like (€3.25 is the monthly cost for one therapeutic food treatment), by having the amount deducted from their pay. At the end of the campaign, Ineco doubles the total amount collected. In addition, employees can vote to decide what solidary action project their donations will finance.

The next project will support the fight against child malnutrition in the region of Darbhanga (India). This will be another joint project with Médecins Sans Frontières (MSF) to continue the work that began last year in Ethiopia.

MSF, which has been operating in Ethiopia since 2004, focuses its projects in this area on assisting the victims of violence, epidemics, pandemics and nutritional crises. ✱

Our technology goes a long way, more than 5,000 kilometers from here

Medina-Jeddah-Mecca line, 444 kilometers of Spanish high-speed lines in Saudi Arabia

Adif is proud to be part of the consortium made up of Spanish companies that will build and be responsible for operating the new high-speed rail line connecting the cities of Medina and Mecca, a major project with an investment of more than €6,700 million. The desert high-speed train will link both cities in approximately two hours and a half at more than 300 kilometers per hour. Adif, a public enterprise that is accountable to the Ministry of Public Works of Spain, will export its knowledge and technology; an expertise acquired after decades working on railway development and promotion projects in Spain, which has made us the European leaders in high-speed systems. Adif takes on with enthusiasm its role as the company that will coordinate the work of the construction companies, the commissioning of the line, its operation and that of the stations, train circulation, safety, and line maintenance tasks for the next 12 years. Adif spares no effort for Spain to export its high-speed systems, maybe the best high-speed systems in the world.

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