CASE STUDY

SOUTH EUROPE ATLANTIC HIGH SPEED LINE: HEAT EXCHANGERS

INNOVATION: TEMPERATURE REGULATION WITH GROUND-COUPLED HEAT EXCHANGERS

INVESTMENT: €3.2M

O&M SAVINGS: €200,000 P.A. IN OPERATIONS AND ENERGY COSTS;
€700,000 IN MAINTENANCE OVER 10 YEARS.

PAYBACK PERIOD: LESS THAN 15 YEARS

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INNOVATIVE AND AGILE: LISEA, THE HIGH SPEED RAIL INFRASTRUCTURE MANAGER INTRODUCING NEW IDEAS

A system of 'ground-coupled heat exchangers' is regulating temperatures inside signalling cabinets beside the South Europe Atlantic high speed railway in France. The idea has been used for the first time on the French rail network, emerging from the team behind the public private partnership project to bring substantial reductions in environmental impact as well as energy and maintenance costs.

Metal air vents can be seen protruding from the ground at regular intervals beside France's South Europe Atlantic (SEA) high speed railway. With the benign appearance of small capped chimneys, these vents are actually the tell-tale signs of an innovative system of ground-coupled heat exchangers.

There are 35 sets of chimneys along the 302km of the SEA between Tours and Bordeaux, at signalling sites where **heat exchangers are used to control the internal temperatures of equipment cabinets**. At each site, air is drawn in through the vents and along buried pipes to provide cooling in summer and possible warming in winter, for technology including computer systems housed in small masonry buildings.

It is a remarkably **simple system**, but its introduction represents a significant achievement for the team behind the SEA. Innovating with any deviation from the norm is not easy in France's regulated rail industry – understandably so, given the attention paid to safety and management of risks. Added to that, the SEA was developed as a public private partnership project, with the extra layers of contractual and financial obligations inherent to PPPs.

In 2011, a 50-year concession was finalised between France's rail infrastructure owner SNCF Réseau (RFF at that time) and LISEA, a special purpose vehicle and project company formed by a consortium of Meridiam, Vinci, Caisse des Dépôts and Ardian.

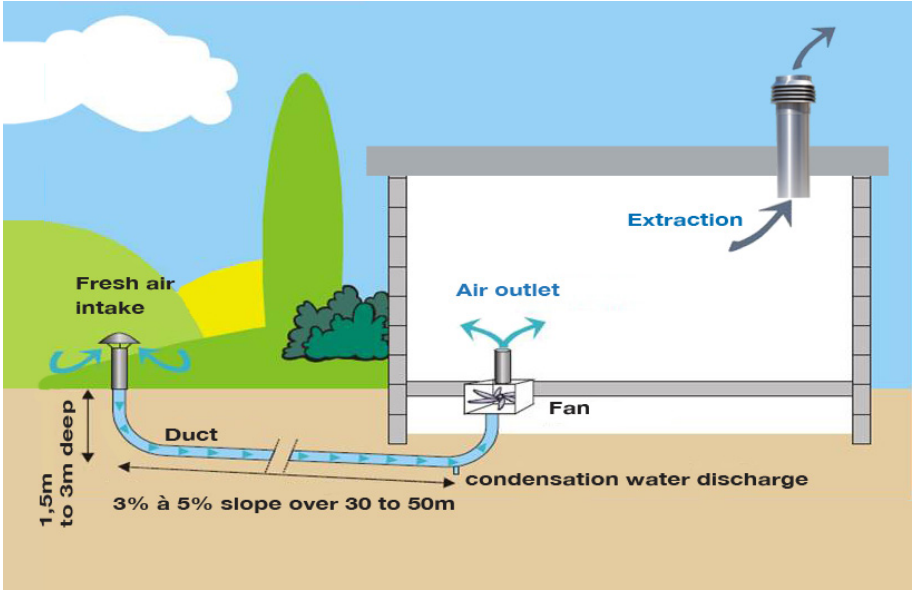
This handed LISEA responsibility for the design, construction, financing and operation of the new high speed line up to 2061. Contracts wrapped up in the overall agreement put design and construction in the hands of COSEA (a joint venture of companies led by Vinci) and contracted the maintenance and operation[1] of the line to MESEA (Vinci and Systra). The project, also including 38km of connections to the stations, was valued at €7.8bn. The line opened to traffic in July 2017, ahead of contractual schedule.

"This was a huge project and the first time that such a big infrastructure development was to be built and operated by the private sector over a period of more than 40 years. Construction started in 2012, but we were looking for ways of increasing the project's sustainability before then, when we were developing our detailed designs for the scheme," says Meridiam's Alexis de Pommerol, who was then LISEA Vice-President for Operation.

"The whole team was engaged in the process, working together to find ways of lessening the SEA's environmental impact. We all knew it was a sizeable challenge. **It's not easy to introduce a departure from standard designs in rail systems and it can be difficult to make changes under the contractual regime of PPP projects**.

"However, we drew up and discussed the merits of five to 10 different ideas. This one, for reducing

[1] the train operations are provided by SNCF (and other rail operators from 2020)



energy consumption at signalling equipment sites, originally came from COSEA system engineers and was selected because it was considered entirely feasible. **The technology was well proven, though not used on a railway before**," Alexis says.

The conventional method of regulating the temperature of signalling equipment cabinets involves use of energy-hungry air conditioning units. LISEA's proposed alternative would use a system of 'Canadian Wells'; drawing air through 300mm pipes running horizontally through the ground for a distance of about 30m at a depth of around 1.5m. Soil temperatures remain constant at all times at this depth, so heat exchange between the pipes and surrounding soil keeps a consistent supply of regulating air flow to the equipment cabinets.

The LISEA, COSEA and MESEA team still needed to **convince client, regulator and funders**, as well as their advisors, that the system could be installed at minimal risk, however. This it did with detailed analysis of the technical and financial merits of the proposal.

"This involved all stakeholders. The contractual arrangement of the SEA concession includes strict criteria of performance required with a strong regime of penalties applicable if service levels fall below expectations. We had to analyse the proposal for the heat exchangers in partnership, to ensure no one would take on any additional risk," says Alexis.

Reports on COSEA's heat exchanger designs were produced for the client SNCF Réseau and the French Rail National Safety Agency EPSF, as well as for technical advisors representing the project lenders. MESEA played an important role in this, advising on the proposal's likely impact on operational aspects. It was MESEA personnel – many of them experienced high speed rail engineers from Systra – that designed the SEA's safety management system and the line's maintenance plan.

"It's been proven on other high speed lines, that efficient temperature control in signalling cabinets dramatically improves the lifespan of electronic equipment," says MESEA Président, Jean-Bruno Delrue. "Air conditioning units, which are conventionally used to regulate cooling, demand accurate preventative maintenance, delivered through expensive specialist subcontracts. The solution developed by COSEA presented a lot of benefits from an O&M point of view: **lower maintenance costs, less energy consumption and better reliability**."

The analysis showed that in return for a capital investment of €3.2m, installation of the heat exchangers would bring about a 32% reduction in the electricity needed for regulating signalling cabinet temperatures. This equated to a saving of €200,000 per year from reduced energy and operational costs, plus a saving of €700,000 over 10 years from reductions in maintenance. The investment would be paid back within less than 15 years.

"This was well within the payback period needed to get the approval of the project lenders and it gave a strong justification for modifying the contract," Alexis says. Contractual changes were needed because the additional investment would bring more work for COSEA and reduced maintenance costs for MESEA.

"We were effectively taking revenue from one and giving it to the other, so the contracts had to reflect this. The work that followed demonstrated a lot of agility in the project financing. It's usually virtually impossible to change the way money is exchanged between parties of PPP contracts after financial close, but we managed it, in partnership and with a lot of open debate as well as technical design and validation," Alexis says.

All 35 signalling equipment sites including the heat exchange systems were built in 2015 and 2016, a year and more before the SEA's July 2017 opening and well in advance of the line's systems testing. "We had plenty of time to monitor and refine the installations and the heat exchangers' operation before the line opened," says Alexis.

Jean-Bruno says: "**We are satisfied with the performance of the heat exchangers**, particularly under the extreme temperatures of the summer 2017 heat-wave. Fine-tuning of operations has been required for two signalling rooms, but overall, **ultra-light maintenance** has been required so far."

"Importantly, this development has shown **privately financed projects can introduce innovation and reduce the carbon footprint of transportation infrastructure**," says Alexis. "The initiative involved all stakeholders and it all came from within the team. There was no regulatory or contractual requirement behind it; just a group of people with an idea."

And could it be used again? "Yes, it's something that ought to be easy to implement on other similar projects with lots of energy use," Alexis says. Jean-Bruno adds: "LISEA and MESEA will continue to monitor performance and we understand that **SNCF Réseau is now considering introduction of the same system elsewhere** on France's high speed rail network." ■

INNOVATION AT PLAY ON SOUTH EUROPE ATLANTIC

LISEA is entitled to receive revenues from the train operators: primarily SNCF, and from 2020, other rail operators with the implementation of the European open access policy. **Revenues are Track Access Charges (TACs) related to the provision, access and utilisation of the line**. The TACs comprise a variable charge based on the infrastructure capacity reservation right payable per train slot, plus a lump sum charge relating to the access right and the actual utilisation by a train of a section of the line. These charges depend on the train characteristics (primarily the number of seats). In addition, LISEA is compensated by the operators for the energy costs.

LISEA therefore needs to maintain records of the trains travelling on the line. A dedicated information system (IS) has been developed since 2015: it is fed by data received (mostly in real time) from the IS of SNCF Réseau and SNCF Mobilités. SNCF Réseau centralizes the slot requests by the operators and allocates the train paths. It also tracks the actual train movements over the network. SNCF Mobilités provides details about the train configuration (anticipated and actual).

To cross-check and amend when necessary the above data, LISEA has deployed specific equipment to record the train movements. The LISEA teams considered several options, including optic sensors, but eventually chose **a very robust solution, based on one of the most reliable components of the railway**: the signalling system (ERTMS). Each commercial train moving on the line has a **unique GSM-R signature** (equivalent to a unique phone number) used to communicate with the line ERTMS, the other trains or the ground operators. ■