EXPRESSION OF INTEREST

SEPTEMBER 28, 2015

CALIFORNIA
High-Speed Rail Authority
770 L Street | Suite 620 MS 2 | Sacramento, CA 95814

DELIVERY OF AN INITIAL OPERATING SEGMENT FOR IOS-SOUTH (MERCED TO BURBANK) AND IOS-NORTH (SAN JOSE/MERCED TO BAKERSFIELD), OR BOTH

RFEI HSR #15-02

TYPSA Group
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Table of Contents

Expression of Interest Cover 1

Table of Contents 0

11.2 Transmittal Letter 0

11.3 FIRM EXPERIENCE AND TEAM STRUCTURE 2

SIMILAR PROJECTS 3

SIMILAR SERVICES 6

TEAM STRUCTURE 7

11.4 PROJECT APPROACH 8

11.5 RESPONSE TO QUESTIONS 9

11.6 COMMERCIAL QUESTIONS 10

11.7 FUNDING AND FINANCING QUESTIONS 13

11.8 TECHNICAL QUESTIONS 14

11.2 Transmittal Letter

Ms. Rebecca Harnagel
California High-Speed Rail Authority
770 L Street
Suite 620 MS 2
Sacramento, CA 95814

RE: Request for Expressions of Interest for the
Delivery of an Initial Operating Segment RFEI HSR # 15-02

Dear Ms. Harnagel:

The TYPSA Group (TYPSA) is pleased to submit this Expression of Interest (EOI) as an individual firm and is very interested in being involved in future contracting opportunities with California High Speed Rail Authority.

TYPSA is a knowledge-driven service provider focused on maximizing value for our clients. Internationally recognized as a consulting partner in the fields of transportation, water, urban development, renewable energy and environment, we fulfill program and project multidisciplinary needs from concept to completion. With a real commitment to sustainable development, we contribute to economic growth by creating a local presence where we provide services, by opening permanent offices, hiring and training local staff and sharing our knowledge and business approach. Being close to our clients helps us better understand their challenges and enables us to provide successful solutions designed to their specific needs.

TYPSA's North American subsidiary is AZTEC, a multidisciplinary engineering and environmental consulting firm structured to serve on a wide range of public and private projects. Through AZTEC, TYPSA provides professional services to our USA clients from our offices in California, Arizona, Colorado, Florida, Indiana, Nevada and Texas.

TYPSA offers the following key benefits to the California High Speed Authority:

- **Local and international experience in the High Speed Rail field**. Over the past 20 years, TYPSA has developed studies for all phases of HSR project development (from pre-feasibility to Detailed Designs and Construction Supervision) for more than 2,920 miles of HSR, in countries including USA, Spain, Brazil, Saudi Arabia, Portugal, France, Italy and Pakistan.
- Integrity and professionalism are strengthened by our **full independence**. The company is owned by its employees and has no ownership links with contractors, manufacturers, developers or financiers.
- The Group has achieved a **high level of specialization** in its core business areas, such HSR design. Sector leaders within its senior staff contribute to the development of innovative solutions in projects across the world.

- TYPSA's services cover the **full project cycle**, from the planning phase to the operation and maintenance of infrastructure. In order to contribute to the **sustainability** of the project, we help build and strengthen the capacity of institutions, communities and other stakeholders to promote knowledge transfer and exchange.

The development of the High Speed Railway network in Spain, the longest HSR in Europe, second in the world to China, allowed TYPSA to become the leading civil engineering consulting firm in the country, and to accumulate a tremendous amount of experience both in the design and construction supervision of HSR.

Therefore, although this RFEI is not addressed directly to engineering design companies, TYPSA would like to submit this EOI to share with the California High-Speed Rail Authority our recommendations and suggestions from the HSR designer point of view.

Thank you for reviewing TYPSA's EOI for the delivery of the Initial Operating Segment North and South of the California High Speed Rail. Should you have any questions or require additional information, please contact Carlos Tarazaga directly at +34 917 227 300 or by email at ctarazaga@typsa.es.

Sincerely,
TYPSA Group

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11.3 FIRM EXPERIENCE AND TEAM STRUCTURE

FIRM EXPERIENCE

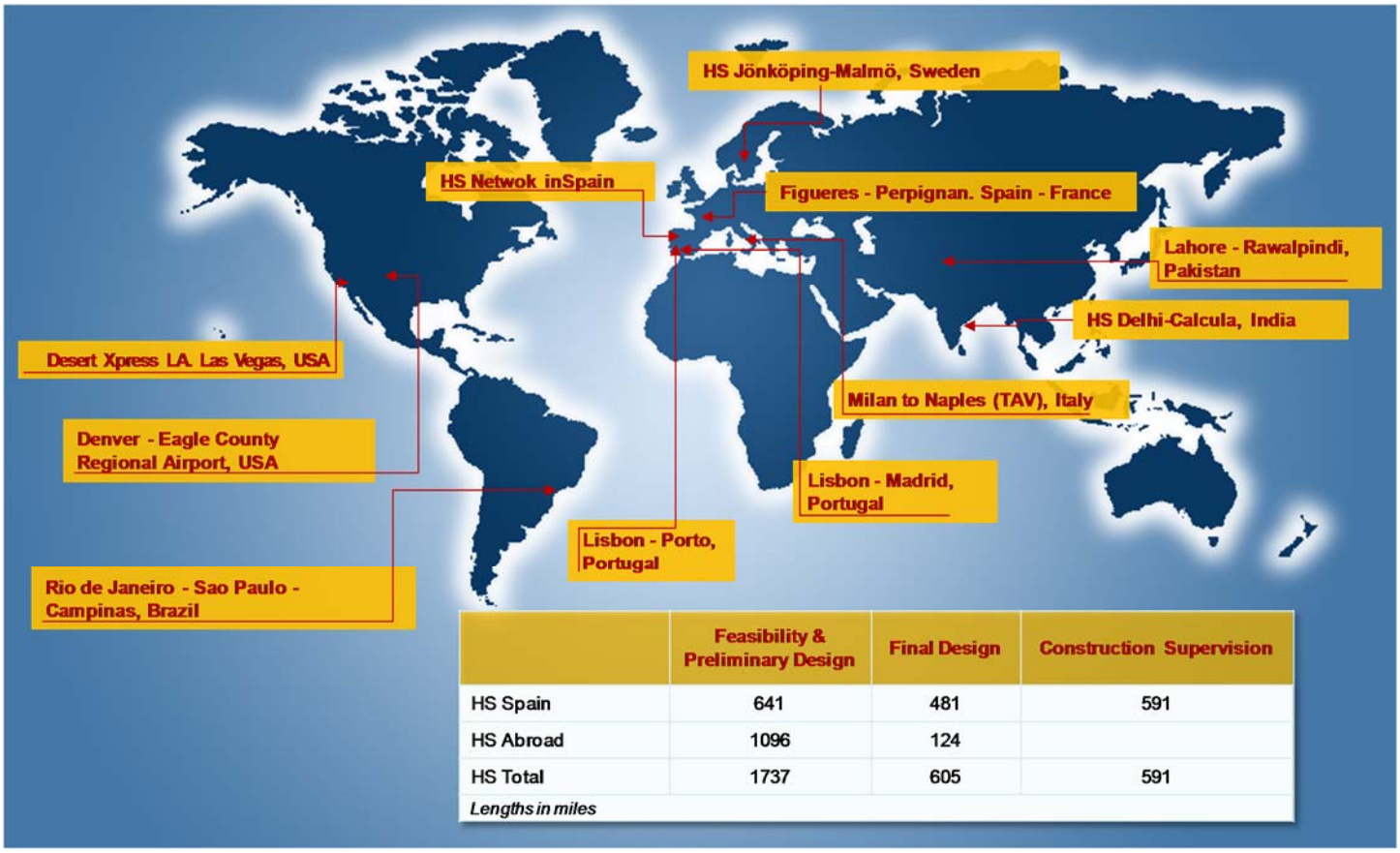
TYPSA works as one company providing civil engineering, architecture, building technology, energy and environmental consulting services around the world. With more than 49 years of experience and 2,500 employees, TYPSA is the leading Spanish exporter of infrastructure-related professional services.

TYPSA has participated in the development of all types of infrastructure and facilities across both Spanish and international markets since its inception in 1966 and takes pride in contributing to better living conditions the world over. With 36 permanent international offices, we have experience in more than 60 countries.

SIMILAR PROJECTS

TYPSA has more than 49 years of experience in inter-urban transportation systems and during this time we have designed 4,349 miles of inter-urban railway and 2,920 miles of High-Speed railway.

The following is a summary of TYPSA's related HSR project experience:



	Feasibility & Preliminary Design	Final Design	Construction Supervision
HS Spain	641	481	591
HS Abroad	1096	124	
HS Total	1737	605	591

Lengths in miles

DESSERT EXPRESS (XPRESSWEST) HIGH SPEED RAIL TECHNICAL DUE DILIGENCE; LOS ANGELES, CA TO LAS VEGAS, NV (DRAGADOS)

- Estimated $6 billion High Speed Passenger Train
- 200-mile high-speed rail between Southern California (Victorville) and Las Vegas, Nevada
- TYPSA performed a due diligence study to evaluate the feasibility of the project as well as the determination of probable costs

COLORADO ADVANCED GUIDEWAY SYSTEM; CO (COLORADO DEPARTMENT OF TRANSPORTATION)

- 111-mile-long corridor
- Mountainous terrain
- Connecting the Denver urban area with major ski resorts and Eagle County Regional Airport
- TYPSA performed the feasibility study for a High Performance Guided Mass Transportation System along the I-70 Corridor

LAX TO ORANGE COUNTY MULTIMODAL, HIGH-SPEED GROUND ACCCESS STUDY; LOS ANGELES & ORANGE COUNTIES, CA (SOUTHERN CALIFORNIA ASSOCIATION OF GOVERNMENTS)

- Estimated construction costs: $10.4 billion
- 100-mile corridor
- Feasibility studies to analyze alternative technologies, routes, stations, ridership parking, access, forecasts, joint development, interim improvements, environmental impacts and financing

LAX TO PALMDALE MULTIMODAL HIGH-SPEED GROUND ACCESS STUDY; LOS ANGELES COUNTY, CA (SOUTHERN CALIFORNIA ASSOCIATION OF GOVERNMENTS)

- Estimated construction costs: $19 billion
- 90-mile corridor
- Project Management and Task Leader for this SCAG sponsored project from Los Angeles International Airport

MADRID – SEGOVIA-VALLADOLID / MEDINA DEL CAMPO HSR LINE SECTION: SOTO DEL REAL – SEGOVIA

- Estimated costs: $354 million
- 9.3 miles
- 31-ft Tunnel Diameter (External)
- 2 Tunnel extensions
- Construction Supervision and Technical Oversight.

MADRID – ZARAGOZA – BARCELONA – FRANCE HSR LINE SECTION: FIGUERES-PERPIGNAN

- 29.5 miles
- 5 mile long Twin tunnel
- Lead Consultant for the Construction Supervision and Operation for the Concessionaire.

HS RAILWAY CONNECTION IN UIC TRACK GAUGE BETWEEN ATOCHA AND CHAMARTIN STATIONS

- 4.3 mile urban tunnel
- $208 million
- Preliminary design, final design and construction supervision.

HIGH SPEED LINE (TAV) RIO DE JANEIRO - SAO PAULO

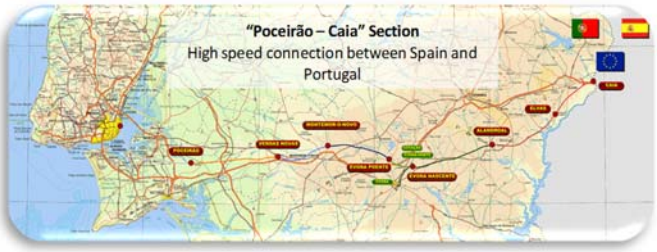
- 322 miles
- 60 miles of TBM Tunnel
- 9 stations
- Advisory services and technical support for the tender for concession. Optimization of alignment design and complementary studies

HIGH SPEED LINE MADRID-ZARAGOZA-BARCELONA-FRENCH BORDER

- 21.2 miles
- Construction costs: $550M
- TYPSA developed seven contracts for the Preliminary and Detailed Design, Construction Management and Supervision works.

HIGH SPEED LINE MADRID-LISBON. POCEIRAO-CAIA

- 100 miles
- Construction costs: $970M
- TYPSA developed Preliminary design for the Concessionaire, including energy systems, track design, catenary design, signaling and telecommunications.



SIMILAR SERVICES

TYPSA offers a wide-range of engineering and consultant services, such as:

ENGINEERING	CONSULTING
▪ **Studies and Planning** ✓ Master Plans ✓ Feasibility Studies ✓ Environmental and Mitigation Studies ✓ Social Impact and Public Participation Studies ✓ Traffic Demand Studies ✓ Economic and Financial Investment Studies ✓ PPP and Concession Studies ▪ **Design Projects and Tender Support Services** ✓ Program and Project Management ✓ Schematic Designs – Preliminary Designs ✓ Final/Detailed Designs ✓ Preparation of Tender Documentation ✓ Tender and Contract Award Services ✓ Right of Way Permitting ▪ **Construction Services and Infrastructure Management** ✓ Construction, Engineering and Inspection ✓ Health and Safety Coordination	✓ Environmental Control Laboratory ✓ Construction Project Management ✓ Maintenance and Operation Management ✓ Identification, Management and Evaluation of Projects and Programs ✓ Technical Assistance and Training ✓ Public Involvement and Outreach ✓ Organization of Seminars and Industry Events ✓ Statistics, Inventories, Land Registry and GIS ✓ Support Services for Administrative Procedures

TEAM STRUCTURE

To the extent that the Respondent is submitting an EOI as part of a joint venture or consortium, then the EOI shall include a description of the proposed team structure, including what strengths and experience each entity brings to the overall team.

TYPSA is submitting this EOI as an individual firm. TYPSA's in-house team provides all of the specialties related to HSR consulting, design and implementation, such as:

- **Planning and demand:** transportation plans, demand studies, field surveys, cost-benefit analysis, financial evaluation, analysis of concession models
- **Infrastructure:** earthwork, alignment design, geotechnical evaluation, tunnels, viaducts and structural designs, depots and maintenance yards
- **Multimodal stations:** flow analysis, integral functional evaluation, architectural design, intermodal connection, urban integration, fire protection, evacuation
- **Track:** ballast, slabs, sleepers, switches
- **Electrification:** Overhead contact lines 1x25 kV and 2x25 kV, substations, autotransformer equipment, power supply lines
- **Safety and communication systems:** Simulation studies, signaling design and interlocking, communications, automatic train protection ERTMS 1-2, communication system GSMR and Fixed, operation tests
- **Operations and maintenance**
- **RAMS & Security analysis**

11.4 PROJECT APPROACH

The Authority would like to know whether each Respondent is interested in the IOS-South scope, IOS-North scope, or both, as well as any recommendations for improvement to its delivery strategy. The EOI shall include a description of how the Respondent will approach each project scope and how each approach will meet the goals and objectives of the Authority and the hurdles to overcome to deliver the project(s) on time and on budget.

This section of the EOI shall also include any innovative ideas for delivering both projects.

TYPSA is a lead design company with more than 20 years of experience in HSR projects around the world. We have been involved in different delivery strategies for these kinds of projects, including DBFM projects.

TYPSA provides, management and technical capabilities and local and international resources to participate in both sections (IOS South and North) under a DBFM contract or different scheme.

TYPSA is able to participate as part of the Design Joint Venture to support the Developer(s), and Contractor(s) of the future DBFM in all the technical areas for the development a High Speed Line.

In our experience, establishing solutions with third parties is one of the greatest challenges in projects of this magnitude, and one of the success factors to meet the goals and objectives of the Authority is setting up a clear basis for the various consultation activities. A well-structured meeting plan, clear meeting proceedings, and communication via digital channels contribute to a quick and effective distribution of information within the organization. A decision log will be maintained for the continuous verification of decisions which have been made.

Finally, TYPSA will develop Value Engineering exercise to identify and eliminate unnecessary costs, while improving functionality and quality of the High Speed Rail System. The aim is to increase the value of the final product, satisfying the performance requirements at the lowest possible cost, involving the availability of materials, construction methods, design elements, site limitations or restrictions, planning and organization, etc. Benefits that can be delivered include a reduction in life cycle costs, improvement in quality, reduction of environmental impacts and others.

11.5 RESPONSE TO QUESTIONS

The majority of the EOI should focus on the questions submitted below. The Authority is very interested in the feedback provided by industry in response to these questions and encourages Respondents to respond in detail.

11.6 COMMERCIAL QUESTIONS

1. *Is the delivery strategy (i.e., combining civil works, track, traction power, and infrastructure) likely to yield innovation that will minimize whole-life costs and accelerate schedule? If so, please describe how. If not, please recommend changes to the delivery strategy and describe how those changes will better maximize innovation and minimize whole-life costs and schedule.*

   The objective of a DBFM contract is to deliver integrated design, construction and maintenance phases in order to minimize associated risks between these phases.

   The interfaces of all the civil works, track, traction power, signaling and communications in a single DBFM package will allow alternative and innovative solutions and processes more efficiently than when these components are developed separately. Additionally, the likelihood of technical risks and interface risks between railway systems from different suppliers under a different delivery strategy is minimized with a DBFM scheme.

   Therefore, we believe that the appropriate integration, coordination and early involvement of all the members of a DBFM delivery model can accelerate the planning for the operation into service of the High Speed Line.

2. *Does the delivery strategy adequately transfer the integration and interface risks associated with delivering and operating a high-speed rail system? What are the key risks that will be borne by the State if such risk transfer is not affected? What are the key risks that are most appropriate to transfer to the private sector?*

   The proposed delivery strategy transfers the interface and integration risks associated with the components included in the DBFM: civil works and railway systems.

   The risks that will be borne by the State by excluding the Rolling Stock, Operations and Stations from under the umbrella of this DBFM delivery scheme are:

   - Revenue from the HSR services offered
   - Cost and schedule implications of the acquisition of the land needed for the project execution
   - Costs due to the lack of integration between the railway systems on the permanent way and the Rolling Stock
   - Costs due to security and safety issues at the station
   - Costs due operational inefficiencies
   - Cost due to changes of law, standards or regulations

3. *Are there any other components of a high-speed rail system that should be included in the scope of work for each project (e.g., rolling stock, train operations, stations)? If so, how will this help meet the Authority's objectives as stated in this RFEI?*

The integration of all the elements involved in the design, construction, maintenance and operation will help to reduce costs, share risks between the parties involved and in the end, increases the likelihood of providing a reliable service for the final users, the passengers.

Therefore, the addition of the design, construction, maintenance and operation of the future HSR Stations and Rolling Stock under this delivery strategy will provide a more seamless system.

4. *What is the appropriate contract term for the potential DBFM contract? Will extending or reducing the contract term allow for more appropriate sharing of risk with the private sector? If the Respondent recommends a different delivery model, what would be the appropriate term for that/those contract(s)?*

The appropriate contract term varies according to the needs of the public and private sector, and the features of the project. Recent Public Private Partnerships (PPPs) have been in the neighborhood of 30 to 50 years.

Generally speaking, TYPSA is of the opinion that availability payment contracts should be of sufficient length to motivate the builder to ensure high-quality construction. Therefore, for HSR lines, we would recommend to align the contract term with the lifecycle span of the key components of the infrastructure and systems. According to the International Union of Railways (UIC), the European Investment Bank (EIB) and our experience, the range of the lifecycle of high speed lines components are:

Asset	Lifecycle (years)
Slab Track	50-60
Ballast	20-35
Concrete Ties	35-40
Rail Fastening Systems	35-40
Tunnels and Viaducts	80-100
Overhead Contact System Columns	35-40
Signaling Systems	15-20

Therefore, we would recommend a range between 30 and 50 years for the potential DBFM contract.

5. *What is the appropriate contract size for this type of contract? What are the advantages and disadvantages of procuring a contract of this size and magnitude? Do you think that both project scopes should be combined into a single DBFM contract?*

Recent experiences on transportation projects in North America and other countries have demonstrated the capacity and ability of Developers, Contractors, Designers and Maintainers on this type of delivery model with similar size and magnitude.

In order to achieve the most competitive process we would recommend splitting the work in DBFM contracts ranging in size from $5B to $10B.

6. *Does the scope of work for each project expand or limit the teaming capabilities? Does it increase or reduce competition?*

As stated above, we would recommend splitting the work in DBFM contracts from $5B to $10B to maximize competition.

11.7 FUNDING AND FINANCING QUESTIONS

7. *Given the delivery approach and available funding sources, do you foresee any issues with raising the necessary financing to fund the IOS-South project scope? IOS-North project scope? Both? What are the limiting factors to the amount of financing that could be raised?*

The significant amount of uncommitted funds (67%) of the total amount necessary for the construction (CAPEX) of the IOS-North and IOS-South may be an issue that might limit the participation of the private sector.

Therefore, we would recommend to progress on the program of available funding sources by the Authority to increase the interest of the private companies.

The amount from the public sector to invest in these projects may be similar to other recent experiences:

- The Figueres-Perpignan High-speed rail connection between France and Spain. This project was constructed with a 57% public investment.
- The initial segment of Portugal's high-speed rail network was projected to be built with 55% of its budget coming from public sources.
- The new Tours-Bordeaux high-speed rail line in France will be built with 50% public investment from France and the European Union.

8. *What changes, if any, would you recommend be made to the existing funding sources? What impact would these changes have on raising financing?*

As mentioned above, we would recommend securing funding to provide a 50-50% public vs. private funding before the release of any RFP to the private sector.

9. *Given the delivery approach and available funding sources, is an availability payment mechanism appropriate? Could financing be raised based on future revenue and ridership (i.e., a revenue concession)? Would a revenue concession delivery strategy better achieve the Authority's objectives?*

In our opinion, Availability Payment Mechanism is the appropriate delivery approach for this kind of project.

A Revenue Concession would incentivize the Developers to optimize the OPEX, but it can also necessitate higher profitability from the Concessionaire due to the assumption of the revenue risk.

11.8 TECHNICAL QUESTIONS

10. Based on the Authority's capital, operating, and lifecycle costs from its 2014 Business Plan, describe how the preferred delivery model could reduce costs, schedule, or both. Please provide examples, where possible, of analogous projects and their cost and/or schedule savings from such delivery models.

Value engineering is an exercise that involves the DBFM team as the project moves forward, by analyzing and selecting the most cost-effective solutions. TYPSA´s objectives will be to reduce costs and schedule achieving design excellence through the following principles:

- Create teamwork between all the members of the DBFM team and the Authority, with the goal of improving the cost-effectiveness of the project.
- Overcome obstacles, especially when a change is proposed.
- Promote relationships between the parties, through a high degree of cooperation among the DCJV participants.
- Listen carefully to the explanations concerning problems raised.
- Use good judgment.
- Quality improvement of the work processes, products and services.

As mentioned above, High-speed rail lines designed or built in Europe have followed this type of delivery model, requiring a mix of public and private funding. Some of them are:

- The Figueres-Perpignan High-speed rail connection between France and Spain.
- The initial segment of Portugal's high-speed rail network.
- The new Tours-Bordeaux high-speed rail line in France.
- Signaling and Communications systems of the High-speed line Madrid-Castilla la Mancha-Comunidad Valencia-Murcia: Section Albacete-Alicante.

TYPSA has played an important role on some of these projects, providing Value Engineering during the design phases with the goal of achieving cost and schedule savings. The projects include:

HIGH SPEED LINE FIGUERES-PERPIGNAN.

Examples of savings:

- Early identification of design integration needs of all the components (civil works, traction and systems).
- Ballasted track in open line and slab track in tunnels.
- Considerations for maintenance savings during the design.

In 2001 the French and Spanish governments agreed to create a new line between Perpignan, France and Figueres, Spain. On a near north-south axis through the Pyrenees, this would become the prime rail link between the two countries on their eastern border. The line will connect an expanded French Ligne à Grande Vitesse (LGV) network to the Alta Velocidad Española (AVE) high-speed line being built from Barcelona to Figueres, an extension of the Madrid-Barcelona High Speed Line.

TYPSA was the lead consultant for Construction Supervision and Operation of the international sector (Figueres – Perpignan) of the High Speed Railway Line Spain – France. The main characteristics of the project are:

- Design speed: 220mph
- 29.5 miles in length of double track.
- 5m of twin tunnel with 31-feet diameter.
- 11 viaducts with a total length of 2.2 miles
- Maintenance depot of 15 acres.
- Overhead Line System 2x25kV a.c. 50 Hz.
- Four autotransformers 55/27,5 KV and two autotransformers 15 MVA.
- ERTMS levels 1 and 2.
- GSM-R communication systems

The works developed by TYPSA included the verification and validation of the design according to the Spanish and French standards and requirements. TYPSA provided a number of international experts in different areas to ensure the correct application of international standards, especially in terms of interoperability.

Client:
TP FERRO CONCESIONARIA
Project Value:
Construction: $570M
Duration:
06/2004 - 02/2010

HIGH SPEED LINE MADRID-LISBON. POCEIRAO-CAIA.

The project has a length of 100 miles, all of them with a double UIC gauge track, and the last 55 miles (border side) of the infrastructure incorporates a third track with conventional gauge.

The section is subdivided into eight lots. The characteristic features of the project, from the point of track rail, are: a high-speed station and a conventional line in Évora, a maintenance base, two PUEC's AV and three LC, three GDP's of LC, three substations eleven intermediate autotransformer stations, three end autotransformer center and nine technical buildings

Examples of savings:

- Standarization of solutions for viaducts.
- Minimize costs for energy through innovatived substations.
- Optmizations on the vertical alignments.
- Proper selection of materials according to the features of the area.

Design activities included:

- Train tracks
- Buildings and civil works (35 Viaducts with a total length of 11.2 miles)
- catenaries, substations and autotransformer stations, auto remotes;
- essential Infrastructure for signaling and telecommunication;
- RAMS;
- HSE studies.
- Technical Coordination. Development of all railway specialties: Track projects, Electrification, Power Facilities, S & T and RAMS

The design included three phases: Phase 1 was the tender design. Phase 2 reached a level similar to a Detailed Design. Phase 3, conceived for the implementation for construction was not started as the project was put on hold by the Portuguese Government.

The main HS features between Caia and Poceirão:

- Double rail track; UIC Standard
- Overall Section Length: 100 miles;
- Maximum speed Line design 220 mph;
- Electrification system 2x25kV n c / 50Hz.
- Technical Building and civil work,
- The contact line is made with polygonal braced catenaries by supports and hangers on "Y" and a wire contact with mechanical voltage regulation.

Client:
LGV-ENGEN. E CONST. LINHAS ALTA VELOCIDAD
Project Value:
Construction: $970M
Duration:
06/2008 - 08/2011

11. *How does this compare to separately procuring each high-speed rail component (i.e., separate contracts for civil works, rail, systems, power separately)? Please discuss design/construction costs, operating/maintenance/lifecycle costs, and schedule implications.*

According to UIC, building new HSR infrastructure involves three major types of costs:

- **Planning and land costs**, including feasibility studies (both technical and economic), technical design, land acquisition and others (such as legal and administrative fees, licenses, permits, etc.) These costs may be substantial in some projects but they often represent a sunk component of between 5-10% in the total investment amount.
- **Infrastructure building costs** include all those costs related to terrain preparation and platform building. Its amount varies widely across projects depending on the characteristics of the terrain, but usually represent between 10-25% of the total investment in new rail infrastructure. In some cases, the need of singular solutions (such as viaducts, bridges or tunnels) to geographic obstacles may easily double this amount (up to 40%, in more technically difficult projects).
- **Superstructure costs** include rail specific elements such as guideways (tracks) plus the sidings along the line, signaling systems, catenary and electrification mechanisms, communications and safety installations, etc. Individually considered, each of these elements usually represents between 5-10% of total investment.

Once the infrastructure has been built, the operation of HSR services involves two types of costs: those related to the use and maintenance of the infrastructure itself, and those related to the provision of transportation services using that infrastructure.

In general, in all cases the maintenance of infrastructure and tracks represent between 40-65% of total maintenance costs (both in high speed and conventional network), whereas the signaling costs vary between 10-35% in HSR, and between 15-45% in conventional lines. The relative weight of the electrification costs are almost the same in both networks.

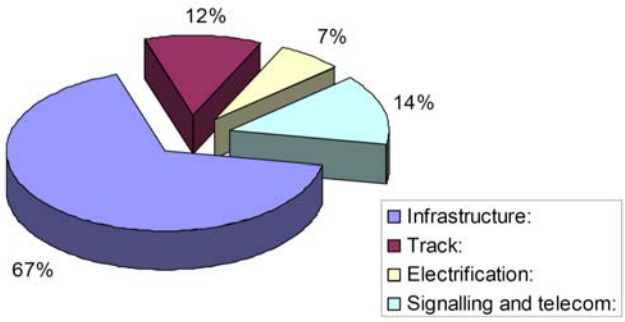
The Spanish experience on High Speed Projects is related to D-B-B delivery models for different components: civil works, railway systems and stations. Breaking high-speed rail projects into smaller pieces increases the chances of competition among firms within the sector, although it creates additional interfaces requiring coordination among various participants.

The following table shows how the High Speed Line between Madrid and Valencia (roughly 240 miles) was split into the following contracts:

D-B-B Contract for	Number of Contracts	Average Length (miles)
Cartography	3	93
Geotechnical Studies	28	9
Infrastructure	35	7
Track	5	47
OHL and Substations	2	100
Signaling and Communication	1	240

The average costs in Spanish High Speed Lines are:

- Infrastructure: 10.3 – 30.9 M USD/mile
- Track: 3.5 – 4.1 M USD/mile
- Electrification: 1.6 – 2.7 M USD/mile
- Signaling and telecom: 2.3 – 6.8 M USD/mile
- Total Cost: 19.3 – 42.9 M USD/mile



12. For each project, are there any technical changes to the respective scope of work that would yield cost savings and/or schedule acceleration while still achieving the Authority's objectives? If so, please describe.

TYPSA is of the opinion that the incorporation of the design and construction of the HSR Stations for the IOS-North and IOS-South under the DBFM delivery model may minimize the risks of lack of coordination during the construction, and therefore to lead to savings on the total cost of each section and accelerate the schedule for the commencement of the operation of the HSR Line.

In TYPSA's experience, optimization of the horizontal and vertical alignment of the track can yield significant savings. A detailed analysis of the capital and operational expenses with respect to the alignment alternatives/refinements will ensure the correct balance and best value for the project.

Also, we consider it is important to involve the final Rolling Stock supplier during the design of the railway systems to avoid interface issues between the components of the signaling and communications placed on the infrastructure and on the train.