



Expression of Interest for the Delivery of an Initial Operating Segment

RFEI HSR#15-02

Beijing National Railway Research & Design Institute of
Signal & Communication Group Co., Ltd.

September 27, 2015



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1.0. Proposal Letter

To: California High-Speed Rail Authority

On behalf of Beijing National Railway Research & Design Institute of Signal & Communication Group Co., Ltd. (CRSCD), which is a wholly owned subsidiary of China Railway Signal & Communication Corporation Limited (CRSC), we would like to express our sincere thanks to your excellency for introducing the above-mentioned project to us. We are very much willing to participate in the project.

With regard to the proposed railway project in California High-Speed Rail Project, CRSCD has accumulated worth-valued experiences and advanced railway technology as well as relatively low construction cost in railway projects and high-speed railways in particular. With our strong ability of design and integration, we can provide the whole system and satisfying “one-stop” customized solution to our customer.

In this letter of intent, we have provided our company profile and our feedback comments on this project. We hereby offer our prudent warranties in respect of the truthfulness and accuracy of all information included in our tender submissions and all evidence documents and materials submitted to California High-Speed Rail Authority. In the event that such materials or information is found to be untruthful or erroneous, you have the right to declare the invalidity of our submission.

In order to accelerate the cooperation between the two sides, we are looking forward to a “one-to-one” meeting with you to facilitate our further study of and proposal preparation for this project. We look forward to the cooperation with you regarding the aforesaid railway project. We assure you that we will do our best to contribute our experiences, technology and effort to your esteemed country and deliver a perfect project under your arrangements and instructions.

Many thanks for your kind consideration and best regards,



Managing Director, Xiaodong Zhao

Beijing National Railway Research & Design Institute of Signal & Communication Group Co., Ltd.

September, 27, 2015





2.0. Company Profile

2.1 Affluent Experience with Long Developing History

CRSCD was formerly under by the Ministry of Railways which could be traced back to 1953. We are the first professional company that is dedicated to rail transit signal and communication research and design in China. Through sustained efforts and development over the past 62 years, CRSCD has become one of the largest rail transportation control system solution providers and a global industry leader, which plays a key role in supporting the safe and efficient operation of the national rail transportation. Its parent company, China Railway Signal & Communication Corporation Limited, was listed at HK Stock Exchange on August 7th, 2015. As of the end of August, 2015 our accumulated construction and operational experience in high-speed railway control systems covers over 13,000km of railways, and the total mileage of high-speed railways using the company's products ranks number one in the world to establish a strategic and dominating coverage in the rail transportation market.

2.2 “One-stop” Service with Safe and Reliable Products

Our major business covers engineering design, engineering consulting, applied research, standard drafting, equipment supply, system integration and verification. Our main system products include Train Control System for Railway, Train Control System for Intercity Railway, Train Control System for Urban Rail Transit, Automation System for Freight Transport, Automation and Monitoring System for Traffic Dispatching, Wayside Equipment and Communication, IT and Service Products. We have awarded IRIS system certification, ISO 9001: 2008 quality management system certification, ISO 14001: 2004 environmental management system certification and GB/T 28001: 2001 occupational health and safety management system certification and CMMI certification. We established a complete quality and safety system to provide safe and reliable products through the implementation of strict product access and demonstration system, the introduction of the world's advanced technology and product testing and demonstration system. Our main systems have been passed the European independent third party security assessment certification which means achieving the highest level of SIL-4 in the safety integrity level.

With a strong focus on product design and R&D and through our “One-Stop” business model, we have become the only rail transportation control system solution provider in the world who is capable of independently providing the entire suite of products and services with competitive advantages across the whole industry value chain. Our comprehensive offerings enable us to provide our customers with a complete and convenient one-stop solution, which reduces their construction, operation and management costs and mitigates the incompatibility risks of complex rail transportation connections.

2.3 The Only Authorized Reviewer of Industrial Standards

CDRSD is the only authorized reviewer of rail transportation control system equipment modes and product standards. Until September, 2015, CRSCD has undertaken more than 500 design specifications, standardization and standard design projects in the fields of signaling and communication, including the formulation of the Code for Design of Railway Signaling and the Temporary Provisions for Engineering Design of GSM-R Digital Mobile Communication System of Railways. CRSCD is also the organization responsible for the management of more than 200 currently applicable standards as well as planned standard drafting projects.



2.4 Engineering Design & Consulting Experience

CRSCD has accumulated extensive experience in the design and consulting area with outstanding achievements. Since its foundation, CRSCD has completed more than 7000 survey and design, consultation and cost of construction tasks of communication, signaling, power supply and automation project, and 40% of China's urban transit design are completed by CRSCD. CRSCD undertook a lot of national key projects. In addition, there are more than 70 independently innovated system technologies which are firstly applied in the railway and urban rail transit fields. CRSCD has popularized more than 100 new technologies which create multiple No.1 records of engineering design in China's railway signaling and communication fields, such as,

The first subway line in China: Line 1 of Beijing Subway (1971);

the first electrified railway in China: Baoji-Chengdu Railway (1975);

the first speed-up railway in China: Shanghai-Nanjing Railway (1996);

the first quasi-high-speed railway in China : Guangzhou-Shenzhen Railway (2007);

the first electrified double-track heavy-load railway in China: Datong-Qinhuangdao Railway (2010);

the longest one-step-constructed high speed railway with the highest technical standard in the world: Beijing-Shanghai High Speed Railway (2011).

From 1997 to 2007, Chinese Railway respectively implemented 6 nationwide speed-up renovation projects for the existing railways. The operation speed of all main lines was improved from lower than 120km/h to 200km/h. In some sections, the speed was improved to 250km/h. CRSCD undertook the signaling system and communication system design missions for most afore-mentioned railways.

2.5 Technical Application R&D and Verification Capability

It is necessary for providing the customized One-stop Service promptly depending on advanced and complete R & D facilities, powerful R & D platform, continuous R & D investment and excellent R & D team to ensure sustained and efficient and independent innovation and timely industrialize research achievements.

CRSCD has a laboratory building of over 20,000 square meters, with 34 dedicated laboratories and system laboratories, such as the world leading CTCS-2/CTCS-3 train control system laboratory, CBTC laboratory, CIPS laboratory, the computer interlocking laboratory, the RBC laboratory, GSSAP laboratory, etc. For the future development, the company now is establishing chips application laboratory, High-speed Throughput network laboratory, new generation of metro integration transportation system laboratory, new generation of intercity railway integration transportation laboratory, new generation of freight integration transportation system, and new generation of high speed railway train control system laboratory.

CRSCD has developed the systems and equipment applied to a wide range of areas, including high speed railways, passenger dedicated lines, inter-city railways, conventional railways, urban rail transit, marshalling stations, mining areas and harbors etc.

The main systems include CTCS-3/CTCS-2 train control system, being applicable to high



speed railways, inter-city railways and speed-up existing lines; CTCS-1/CTCS-0 train control system, being applicable to conventional railways and heavy-load railways; FZL/CBTC train control system, being applicable to urban rail transit; CIPS comprehensively integrated automation system, being applicable to marshalling stations, mining areas and harbors; GSM-R interface monitoring system, being applicable to railway GSM-R special mobile communication. CRSCD has independently researched and developed complete kits of basic equipment in rail transport control field such as DS6 series computer interlocking system, LKD2 series train control center, LKR-T radio block center, LKX-T temporary speed restriction server, CTC/TDCS dispatching command system, ZPW-2000A track circuit, wayside balise, ATP/ATO onboard equipment, ATS equipment for urban rail transit, centralized signal monitoring system and safety monitoring system against disasters etc.

2.6 System Integration Experience

CRSCD is capable of providing complete signaling and communication system solutions for rail transport and complete sets of signaling equipment in the fields of mainline railway, classification yard, dedicated passenger line and urban rail transit as well as providing its customers with satisfactory system integration turnkey services in terms of applied research, system testing, field delivery, integrated testing and commissioning, operational maintenance, system delivery and after-sales services to realize the systematic and customized “one-stop” service business model.

Since 2005, CRSCD has been constantly undertaking the system integration project of the signal and communication for Chinese high-speed railway lines, including the Beijing-Shanghai HSR, Wuhan-Guangzhou HSR, which in aggregate has reached over 19,077km (11,853 miles) in terms of mileage by the end of August, 2015, and make us the largest railway control system provider in the PRC in terms of mileage. The line with operation speed over 300km/h (186 mph) extends to 9078km (5641 miles), among which we provide core equipment and implement line opening 8435km (5241 miles), accounting for 93% of the whole. The line with operation speed over 200km/h (124 mph) extends to 9999km (6213 miles), among which we participate construction and line opening 5403km (3357 miles), accounting for 54% of the whole.

Our exceptional System Integration Experience such as: The first high speed railway in China with the longest mileage and the biggest investment and up to the highest standard in the world: Beijing-Shanghai high-speed railway line, whose maximum design speed is 380 km/h; The first long haul main line high speed railway in China up to advanced world level: Wuhan-Guangzhou dedicated passenger line (DPL); The first long haul main line high speed railway in China in frigid area: Harbin-Dalian DPL; The first high speed railway in China in public transport operation mode: Shanghai-Hangzhou high-speed railway; The most complex high speed railway: Shanghai-Nanjing DPL; The first island high speed railway in China: Hainan East Ring Line DPL; The largest classification yard in Asia: Zhengzhou North classification yard.



3.0. Project Costs Management

A. Products are manufactured in CRSC's production facilities so as to ensure the cost and quality

First of all, all products we supplied are manufactured primarily in our group company's production facilities. By the end of August, 2015, we had a total of 13 production bases in 9 cities in the PRC, including the biggest railway signal relay production facility and switch machine production facility in the world. CRSC own sophisticated manufacturing, testing and experimentation machinery and adopt advanced production process to promote efficient production. The group company owned production facilities have 1,299 sets of major machinery which includes, such as chip moulder, wave soldering machine, reflow soldering machine, online testing instrument, balise function testing system, and jointless frequency shift equipment full-suite station. The cost of equipment manufactured at those facilities can apply refinement control, and therefore ensure that the product price is with high competitiveness.

B. "One-Stop" turnkey service

Our "One-Stop" turnkey business model has significant advantages. Leveraging our design and integration capabilities, we provide rail transportation control system solutions to customers as well as a full suite of corresponding equipment. From system design, equipment supply, system debugging, to system implementation and after-sales services, we are capable of offering a comprehensive and convenient one-stop services, and help reduce construction, operation and management costs for customers and to mitigate the system compatibility risks among complicated rail transportation lines.

We possess comprehensive rail transportation control system engineering qualification and abundant project implementation experience. Stick to this "one-stop" turnkey business model, we have, within ten years, completed more than 30 HSR control system and Urban Rail Transit control system projects, in the form of overall delivery, contributing to customers profit in controlling the quality, safety, schedule and costs of their projects.

C. Safe and reliable products help to reduce the maintenance cost

We place paramount emphasis on product safety and reliability. Our solutions and products are outstanding in safety, reliability, availability and maintainability, ensuring an efficient and quality operation all year round, and therefore lowering the cost of operation and maintenance activities. Our core safety products meet internationally recognized safety standards, including European railway product safety management standard EN50126. We have established a quality and safety control mechanism covering the entire lifecycle of the products, including a comprehensive quality and safety management system, testing and verification on product reliability, manufacturing procedure quality control, analytic procedure for malfunction, traceable management, safety assessments over products full lifecycle and complete failure response mechanisms.

We adopt stringent quality and safety development strategies, and established product quality and safety management system through the adoption of standards such as IRIS and CMMI standards. We have been following the European railway product safety management standards EN50128 and EN50129 to enhance the management and control of our core safety products' quality and receiving assessment certification of SIL. All of our major rail transportation control system products had obtained SIL4, the third-party assessment certificate issued by Lloyd's Register



Quality Assurance of the United Kingdom and TÜV Rheinland of Germany. The hazard rate arising from such products' safety functions was $10^{-9} < \text{Tolerable Hazard Rate} < 10^{-8}$, meaning a hazard event would happen once in one thousand years to ten thousand years, representing the world-leading quality level. During the Track Record Period, we had provided control system equipment with outstanding safety and reliability for high-speed railways in operation and in various types of weather and geographical conditions. Our equipment has ensured the safe, stable and efficient operation of each high-speed railway line.

4.0. System Delivery Management

In the process of building Chinese high-speed railways, CRSCD has accumulated systematic construction managerial experiences and is able to effectively control construction duration and construction cost, assure engineering quality, organize, plan and manage implementation of complicated project involving multiple specialties and lines, provide technical assurance for effective handling of various engineering difficulties and undertake rapid implementation and delivery of all kinds of projects.

CRSCD established complete automated design aid tool sets, including automated design of construction drawing; automated configuration tool for engineering data; complete simulation automated testing tool, etc. Annually, CRSCD is capable of undertaking the designing and integration projects of 3000km high-speed railways and 15 large junctions.

The lab testing and verification capability of CRSCD could effectively reduce the risk of system delivery. The simulation test platform is based on half-physical simulation technologies. The test targets adopt physical equipment and actual software, while the EMUs as well as the driving consoles, a large number of wayside equipment (signals, switches, track circuits and balises), the bridges and tunnels and the line parameters are simulated to achieve "1 to 1" lab simulation of the actual line and train control system.

The physical equipment is operated under the simulation environment to support functional testing of the train control systems. The lab supports not only functional testing in normal conditions but also simulation of various fault situations to ensure the comprehensiveness testing of fail-safe functions and the quality of on-site software and data. Lab testing and verification can achieve effective fault reduction during on-site engineering implementation and effective reduction of on-site construction period, and ensure smooth passing of dynamic testing and acceptance testing.

CRSCD provides effective and highly efficient integration management services to Chinese high-speed railways, including system technology integration and design management; schedule integration management; interface integration management; system integration test and delivery.

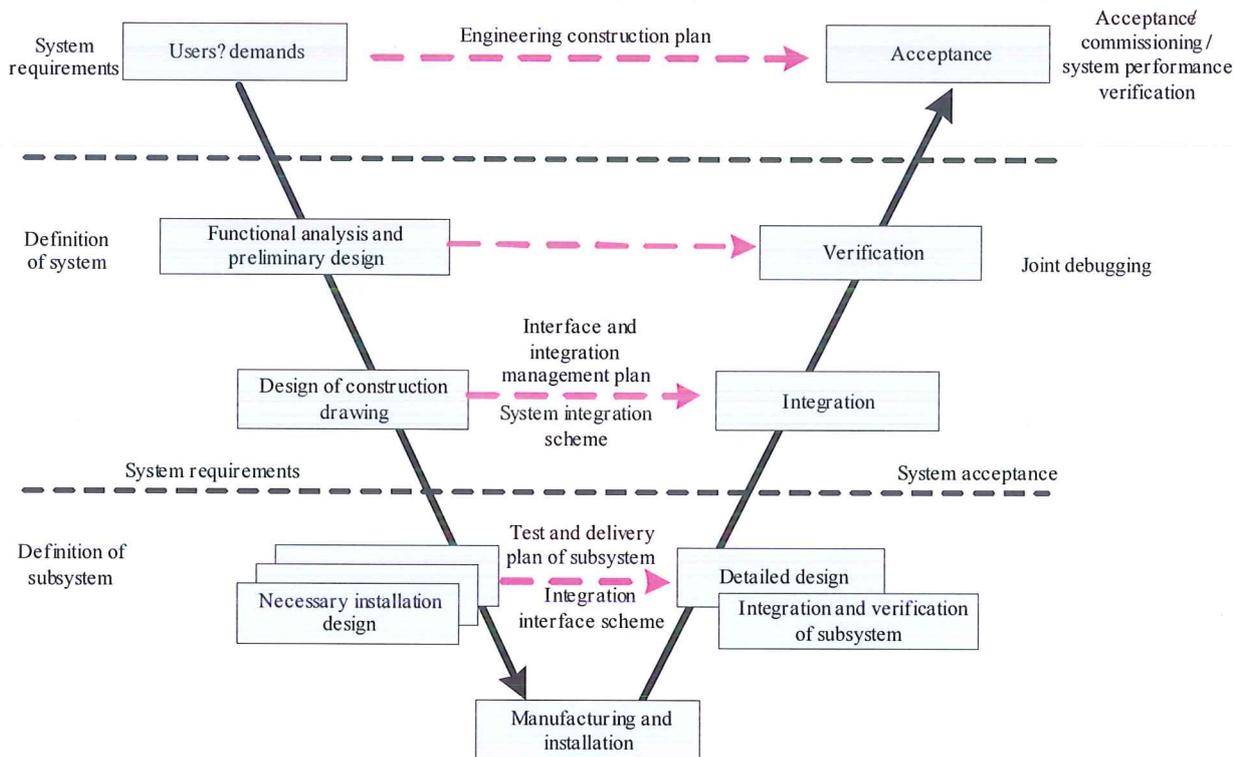
As the Overall Project Management team, we are

- In charge of plan: make work arrangement of the overall system and organize implementation of the plan;
- In charge of users' standards: integrated design makes the system to be delivered meets technical standards of railway users;
- In charge of functions: coordinate functions and interfaces of different systems to be compliant with users' demands; organize system integration and delivery test and verify system functions.



□ Control investment: control system cost, reduce internal change and avoid investment expansion.

□ In charge of users' management: responsible for whole process management and total system delivery; the users only need to accept the result.



Integration management of the total system

5.0. Maintenance Management

Being the core system of HSR, the signaling system shall be provided with effective maintenance service during line operation, so that it can ensure a safe operation and comfortable ride. By now, the total operation mileage of HSR in China has reached 16,000km, and therefore China has established a complete maintenance system with large number of experienced maintenance staff. CRSCD who has borne major scale of HSR signaling and telecom project, has accumulated abundant maintenance experience. Depending on the established comprehensive maintenance system and rich maintenance experience, the CRSCD is capable of satisfying the 30-year maintenance period requirement expected by California HSR Authority.

CRSCD has developed several regulations, procedures and instructions to specify equipment operation, management and maintenance. Dedicated equipment support department is functioned to perform equipment maintenance, periodical inspection and further equipment status assessment. Apart from the dedicated department, the common operators are instructed to perform necessary



basic inspection during daily operation, and report to equipment support department in case any incidents occurs. The equipment support department will immediately distribute maintenance order if judged necessary.

CRSCD provided the Ministry of Railways with technical specifications on S&C agile operation and maintenance system, fully focusing on the maintenance of high-speed railway electrical equipment and realizing intelligent S&C maintenance. In HSR signaling and communication maintenance sector, the CRSCD owns: many operation maintenance data, abundant operation maintenance experience, proven operation maintenance technologies, state-of-the-art operation maintenance concepts, advanced operation maintenance products.

A Complete Solution Provided by the CRSCD for HSR Signaling and Communication Maintenance, could greatly enhance the Intelligence and automation of signaling and communication maintenance. And the agile operation maintenance is realized for the maintenance of HSR signaling system. Fully supervise the equipment status, Duly warning against system risk, Online auxiliary maintenance and repair for signaling and communication, Uniform management of signaling and communication production, to achieve Shorten train stop time due to failure, Decrease accident probability, and Enhance working efficiency of signaling and communication.

6.0. HSR Case Introduction—Beijing-Shanghai HSR Project

A. Project Overview

Beijing-Shanghai High-speed Railway starting from Beijing in the North and ending at Shanghai in the south is the high-speed railway completed to be the longest in the world with the fastest design speed per hour and with the highest standard. The railway is built starting from April 18, 2008 and put into service on June 30, 2011. The total mileage of Beijing-Shanghai High-speed Railway is 1318km (819 miles), for which the minimum operating time is 4 hours and 48 minutes. An average number of 250 high-speed trains are operating on the line every day. Number of passengers transported by Beijing-Shanghai High-speed Railway in the year 2014 is more than 100,000,000 and number of passengers transported in a day is over 290,000.

CRSCD is responsible for overall work regarding signaling and communication system of Beijing-Shanghai High-speed Railway :

- (1) At the earlier stage, carried out complete demonstration and made overall planning of technical system;
- (2) At the intermediate stage, established overall technical solutions according to construction objectives;
- (3) At the later stage, completed construction in 3 years.



B. Technical Features

| No. | Project Features | Technical Difficulties | CRSCD Solutions |
|-----|---|--|--|
| 1 | Maximum design speed per hour is 380km/h (236 mph). | <ol style="list-style-type: none"> 1. Difficult safety control; 2. High requirement for speed adaption of equipment. | <ol style="list-style-type: none"> 1. The control mode of machine control priority is applied. C3 is used as the master control scheme and C2 designed with the same mode as that of C3 is used as the backup mode, which are switchable automatically at constant speed in operation. 2. R&D and application of overall disaster protection technology: invasion by foreign matters, snow and ice protection, electric heating turnout snow melting system, and C2 and C3 dual-mode synchronous disaster protection access technology; 3. GSM-R communication network optimization technology applicable to high-speed operating trains is used to ensure stability of network communication. The technology improving transponder acting scope is researched to be suitable for high-speed operation. |
| 2 | Operation tracking interval is 3 minutes. | <ol style="list-style-type: none"> 1. Efficient transportation command; 2. High stability requirement. | <ol style="list-style-type: none"> 1. Computer-based dispatch and command system is applied to the entire line, handling route automatically according to preset operation chart to reduce the issue of low efficiency of manual operation; 2. Execution of temporary speed restriction command is realized by train control system after analysis once; 3. All critical links of the control system are set up with redundant systems for conversion without interruption. |
| 3 | Interconnection and interworking with CTCS-2, CTCS-3, CTCS-3D, and CTCSS-0 railways along the line. | Linked with lines at different levels and operating across lines and levels. | <ol style="list-style-type: none"> 1. On-board ATP equipment is compatible with different levels. C3 is compatible with C2 and C2 with C0. Single set of equipment may operate across lines. 2. Automatic switching rules among different levels are established and implemented. |



| | | | |
|---|---|---|--|
| 4 | Access to multiple railway junctions, and complicated stations along the line. | Ensure the efficiency of junction entry and exit is not lowered; Station is large and station information is hardly updated under C2 mode. | 1. The entire line is covered by C3 to ensure trafficability of main lines in the hub is not lowered; 2. Mixed transponder set is set up to ensure complete forecast of station information. |
| 5 | The 1318 km Railway line is Completed and Put into Operation Once only. | There is no transition scheme; There is no back-off scheme; succeed in one attempt. | 1. The entire line is designed according to the unified technical principle; 2. Before site deployment, it is required to realize integrated engineering simulation testing technology with complete scene, complete velocity, complete networks and complete functions in the laboratory and carry out offline integrated design verification. |
| 6 | The entire line passes over three Railway Bureaus, involving several governing regions. | High requirements for coordination and command of several governing regions and difficult transportation dispatch and operation maintenance coordination. | 1. Dispatch management mode by local authorities is established and dispatching offices are established in Beijing, Jinan and Shanghai. 2. Three dispatching consoles are set up to alleviate stress of the dispatchers. Information among these dispatching consoles is interconnected to be synchronous and different dispatching offices coordinate with each other to unify the operation schedule. |

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