

Independent Safety Assurance for Fast Developing Railways in China

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1 Background

China is investing heavily in its railways. For mainline railways, the development has gone through roughly the following stages:

- Speed enhancement on existing railways; starting from 1997 the first general speed enhancement has increased the train speed to 140Km/h for some key routes. In the following ten years, China has seen five more general speed enhancements; with the latest (sixth) one, the line speed has been increased to up to 200Km/h on some routes.
- New high speed line building; at the same time China is building more new high speed passenger dedicated lines (PDL). The first new PDL was commissioned in 2003, with a speed of 200Km/h. PDL line construction and commissioning has gathered speed in the past few years, the high profile Wu-Guang PDL commissioned at end of last year has a top speed of 350Km/h. The long debated Beijing-Shanghai high speed railway is now under construction and is expected to be commissioned by the end of next year - it will have a line speed of 400Km/h.
- Exporting Chinese high speed railway know-how; with the success in domestic high speed railway construction, Chinese suppliers are looking at the international market with support from the Ministry of Railway (MOR). Chinese suppliers are building railways in the Middle East and are not only exporting the labour intensive civil construction but gradually extending to technology intensive core systems (signalling) disciplines and rolling stock.

In urban transportation, many cities in China are building underground, light rail and maglev systems. Indeed, large metropolitan cities are building a few lines at the same time with a metro network planned. The first Beijing underground line was commissioned 40 years ago and Beijing only saw one new underground line built in the following 30 years. Beijing metro construction gathered speed at the turn of the century with the Olympic games to be held in 2008 and in anticipation of a rapid population growth. At the time of this paper, Beijing has four metro lines under construction and it is building more new lines. The Beijing Metro Yizhuan Line will be the first line with its Communication Based Train Control (CBTC) signalling system wholly developed by a Chinese supplier.

2 The challenge

The Chinese suppliers need to keep up with the fast development speed whilst at the same time ensuring that safety is not compromised. They are facing some challenges.

The trains are running at increasingly higher speeds and lower headways, requiring new technology to be adopted. For mainline signalling systems, Chinese suppliers are adopting their own system – the Chinese Train Control System (CTCS). It is the equivalent of the European Train Control System (ETCS) being deployed in Europe. The CTCS system basically follows the same principle and structure of ETCS. The newly built PDL lines are equipped with the CTCS Level-3 signalling system, a combination of the ETCS Level-2 system with the local Chinese Automatic Train Protection (ATP) system. The Chinese suppliers have teamed up with their European counterparts to supply these systems. Even in Europe, there are relatively few ETCS systems deployed and the Chinese suppliers need to develop the CTCS constituent equipment whilst at the same time implementing the system in engineering projects.

Metro construction in China is under the supervision of government ministries other than MOR, and there is a strict and explicit rule on the percentage localisation rate. That has put more pressure on Chinese suppliers to develop their own product, and at the same time deliver the engineering projects. The new Beijing metro lines soon to be commissioned are typical examples. The Yizhuang Line is going to be the first line running on a fully home produced CBTC signalling system. Its supplier has started to develop the CBTC system only few years ago, and it is also responsible for the implementing the Yiazhuang and some other lines.

The mass metro construction is a new scenario in China. There is not yet a systematic safety approval and authorisation mechanism comparable to that of MOR and this has presented a challenge to the suppliers and metro administration regarding how the metro safety is assured.

The Chinese suppliers are looking to export the Chinese high speed railway system into the international market and this has been endorsed and actually led by MOR. These suppliers are facing the traditional trade barriers as well as the issues relating to international practices especially in high value-added core systems.

3 To meet the challenges

Lloyd's Register Rail, as an independent third party, helps the Chinese suppliers to meet their challenges by bringing best international practices into China. The work we carry out includes providing training, certification of the products and independent safety assessment of the projects.

3.1 Training

Lloyd's Register Rail has produced a suite of training programs to bring the best of international practice and standards into China. The training material is based on the European standards and UK guidance. EN50129/8/6 standards (now International Standards) are the basic railway safety standards that are practiced in many parts of the world and are most frequently referenced in international projects. Engineering Safety Management (the Yellow Book) is a UK local best practice guide and has been applied for

many years in the UK and referenced in some Asian Pacific countries. It provides good high level guidance on project safety management.

The training courses we provide are aimed at suppliers at all levels, from development engineers to project managers; from software engineers to safety managers; from freshly graduate engineers to experienced practitioners. The training covers all system lifecycle stages from risk analysis to implementation of projects.

We have found that the Chinese suppliers have signalling engineers with good experience, good competence and conscious of the need for safety. The training provided by Lloyd's Register Rail has provided better awareness of international standards so that they can quickly produce EN compliant designs from a position of better knowledge and understanding of what is required in practice.

As the development is happening so fast, the suppliers have to hire and use new people with relatively lower experience to cope with the demand. In this case, our suite of training is available to gradually equip the engineers with the knowledge and mindset of a mature signalling engineer.

We have also helped one key signalling supplier to set up a safety assurance system (SAS) in one instance. The SAS is a full set of corporate procedures that cover all its safety related business including safety related signalling product development; signalling projects from the simplest station signalling upgrading to a complex PDL signalling system construction.

3.2 Independent Safety Assurance

Lloyd's Register Rail has brought the European style independent assurance practice into China. Our independent assurance work is mainly in two areas, product certification under Lloyd's Register Rail's Railway Product Certification (RPC) scheme and Project Independent Safety Assessment (ISA). In both cases Lloyd's Register Rail remains independent from the developer/suppliers as shown in the diagram below.

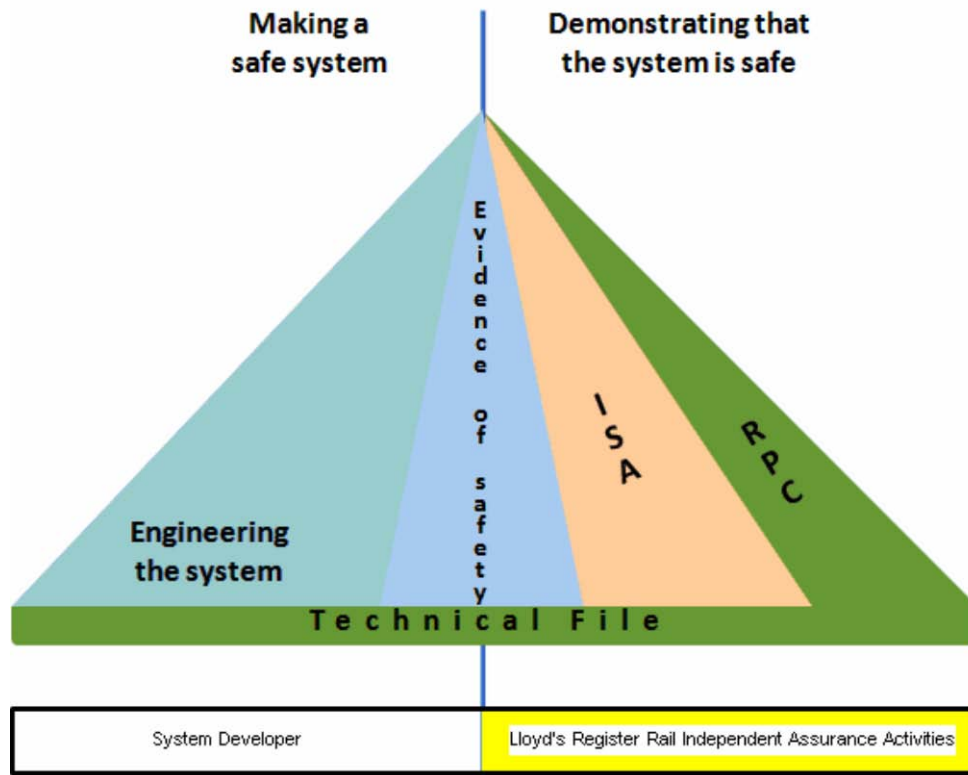


Figure 1: Maintaining Independence

The product certification is a conformity assessment of a safety critical product against EN50129/8 standards. In order to ensure consistent criteria are used by all assessors in performing assessment projects, Lloyd's Register Rail has developed an Interpretive Protocol (IP) against each of the standards. The IP is an explanation or guidance on each clause of the standard. The assessors use the IP to assess the product developed and produce a conformance record (the technical file against each standard concerned).

In performing assessment on the Chinese suppliers and their product, Lloyd's Register Rail has combined local staff with its UK based personnel to provide the most effective team able to apply international best practice, properly tailored to the needs of the Chinese suppliers and products. The RPC projects are led by local offices in China with the support from UK offices. The assessment is performed throughout the project and, at the end of the assessment, evidence and reports are produced by the local office. The evidence is then submitted to a centralised certification process where another semi independent (within Lloyd's Register Rail but different offices) peer review is carried out by UK offices; a positive review result will lead to the RPC certificate being issued.

3.3 Project Independent Safety Assessment

The project ISA has a similar arrangement and Lloyd's Register Rail is doing a significant amount of project ISA work in the new Metros being constructed in China. In relation to the new PDL lines, Lloyd's Register Rail has provided direct support to the Chinese railway certification body - the party responsible for system assurance on the new projects.

For the metro line signalling system construction projects, Lloyd's Register Rail has been acting as independent safety assessor (ISA). At the moment, each project is led by a UK signalling expert, and he is supported by local (Beijing) office assessors and more international office staff. The metro signalling assessment is normally divided according to the project plan into a few stages and at each mile stone stage, the lead assessor will produce an intermediate assessment report. Following successful peer review and approval this will lead to the issuance of a stage certificate allowing the progress of the project into next stage.

3.4 Transfer of knowledge

Lloyd's Register Rail is keen to transfer its knowledge to local industry. Lloyd's Register Rail has set up a joint venture with one local Chinese organisation – the Chinese Classification Society. The new joint venture CCS-LR will provide transportation (Railway) and marine consultancy services to the Chinese market. The new CCS-LR has started to hire local Chinese staff and train them to perform railway product certification and independent safety assessment work. Through company competence management and structured training, CCS-LR will ensure that all local staff carrying out assessment work are competent and that knowledge is vested within this joint venture firm (in China).

Apart from the training we provide to the Chinese suppliers, Lloyd's Register Rail is also providing consultancy and advice to the Chinese safety authority. Lloyd's Register Rail has been providing advice to the Chinese railway certification body in performing PDL line assessment and metro signalling project assessment, and Lloyd's Register Rail is helping this client to set up a procedure for safety assessment. As part of a metro Line ISA project, Lloyd's Register Rail has drafted a set of safety assurance procedures at the request of the Metro Authority concerned.

4 Summary

Chinese railways are developing at an enormous speed and it is likely this will continue for some time. To assure the safety of the railway system, Lloyd's Register Rail has brought the best of international practice and standards into China and transferred the knowledge into local industry. It is also foreseeable that within the near future Chinese suppliers will start to export its high speed rail system into the International market. Lloyd's Register Rail will of course continue to support the Chinese suppliers' entry into the International market as an independent assurance party..