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THE STATUS OF RAILWAY CAB SIGNALLING IN CHINA

In the last two decades, the Ministry of Railways (MoR) offices of the Chinese Government have embarked on large scale expansion of the nation Chinese Railway network specifically to address the huge growth in passenger traffic demand.

The main declared aims were:

- Improved economic productivity and competitiveness.
- Stimulating the economy by creating jobs and driving demand for construction.
- Facilitating cross-city economic integration.
- Supporting environmental sustainability and energy independence.
- Developing an indigenous HS rail equipment industry.

The growth of passenger travel mileage is evident from the following statistics:

- 2011 3,000km actual
- 2013 10,000km actual
- 2016 19,000km current
- 2020 30,000km planned

and by the HS passenger patronage achieved:

- 2007 61 million riders
- 2010 290 million riders
- 2012 486 million riders
- 2014 893 million riders

To achieve these values and meet the anticipated passenger demand, specific steps were determined by introducing leading edge technology initially satisfied by technology transfer from leading European suppliers and adopting this technology through local production and self-sufficiency for both new Rolling Stock and particularly for the Signalling, Command and Control Systems where the highest levels of safety, availability and reliability were being expected and demanded.

In order to facilitate this work the MoR was split into three main working groups namely the Ministry of Transport (MoT) taking care of railway planning and policy, the National Railway and Administration (NRA), a new organisation for administrative functions and the new Chinese Railway Corporation (CRC).

The turning point for these decisions appeared to have been the timing of 2002 UIC ERTMS World Conference held in Beijing where the development of the ERTMS/ETCS solution was presented by the UNISIG suppliers to a large audience of Chinese senior engineers and administrators. By 2003, the MoR had defined the Chinese Train Control Systems (CTCS) describing Levels 0 to 4 combining, in Levels 1 – 4, the key attributes of the ERTMS solution but adopting the advanced track circuit technology omni-present in the Chinese national rail network.

The earliest Cab signalling introduction project was realised on the Beijing to Tianjin (117km) line by a consortium of European and Chinese suppliers providing the capability of operation up to 350km/h where ETCS Level 1 is operational. This line opened just before the Beijing summer Olympic Games of 2008 and was equipped with both ERTMS Level 1 and CTCS Level 2. Following on rapidly was the Wuhan to Guangzhou HS line in 2009, the first CTCS Level 3 line, followed by the Zhengzhou to Xi'an HS line. Technical implementation was achieved by the Chinese signalling industry under a contract in which European suppliers committed to provide significant technology and engineering know-how and capability transfer of their ERTMS Safety Integrity Level (SIL)-4 products to China.

Principal features of the CTCS grade levels

CTCS Level 0 and 1 are related to the legacy cab signalling warning system where CTCS Level 1 is supplemented by trackside balises and a Eurobalise reader attached to an LKJ on-board unit reading some trackside information from a Eurobalise via packet 44. The system is designed to support speeds up to 160 km/h.

CTCS Level 2 makes use of ERTMS type data packets such as for "gradient", "linking" and "static speed profiles" but the significant difference is that the system does not read a Movement Authority (MA) from the Eurobalise as an ETCS Level 1 system would. Instead the MA is computed by the on-board unit combining trackside data from the Eurobalise with a track circuit code indicating the number of blocks ahead free. There is a maximum of 7 blocks ahead of a train which can be managed by a "Train Control Centre (TCC)" located alongside the track and connected via Lineside Electronic Units (LEUs) utilizing switchable Eurobalises in the track.

The "End of Authority" and the related speed profile are indicated on the DMI such that no lineside signals are required. The system is limited to a design speed of 250 Km/h.

CTCS Level 3 as the high end ATP capable of dealing with speeds up to 380 Km/h has a very similar ERTMS Level 2 type architecture and comprises Radio Block Centres (RBC) and a GSM-R radio communications infrastructure and on-board data radios. There are national adaptations with respect to functionality and dynamic transition between CTCS Level 2 and CTCS Level 3 and vice versa.

CTCS Level 4 is an option for future development of the Chinese train control standards toward a radio based moving block system comparable in some degree to the concept of ERTMS Level 3.

By the commencement of 2016, Chinese Railways had installed nearly 19,000 km of High Speed Lines operating at line speeds of 250 – 350 km/h. The CTCS Level 3 (C3) is similar to the European ERTMS Level 2 and is the leading ATP system on the High Speed Lines, overlaid on a CTCS Level 2 (C2) system, providing the trackside infrastructure for EMUs running 200 – 250 Km/h on Dedicated Passenger Lines (DPL).

The CTCS Level 2 together with the CTCS Level 1 traditional cab signalling system have been in operation for some time on approx. 10,000 track km of the DPL Network, providing an infrastructure dealing with both passenger and freight traffic. Although not developed along the CENELEC process CTCS Level 2 overlaid by CTCS Level 3 is very similar to an ETCS Level 2 SIL 4 based ATP.

SUMMARY

The Chinese High Speed Passenger Line ambitions will continue to focus on the target of greater frequency, reliability and safety and improved capacity to provide services to a hugely demanding and growing travelling public at a domestic level. There are further clear indications of the Chinese Government's intention to almost double the number of track kilometres for new Dedicated Passenger services in the coming years.

The European suppliers have joined long term and detailed discussions through the core UNISIG members to ensure that the ETCS Level 2 solution is fully interoperable over standards air-gaps and is in full compliance with the relevant CENELEC standards whilst the Chinese CTCS products retain certain aspects of the CENELEC standards. There is a continuing and traceable reliance for the CTCS grades of ATP on the now "Globally" available ETCS Levels 1 and 2 standards which have now been adopted by more than 47 countries in the World and which clock-up safely hundreds of millions of passenger kilometres each year.

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