

## 城市轨道交通运营安全的第三方评估

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随着城市化的发展,保证城市轨道交通的运营安全已越来越成为运营管理的重要工作。城市轨道交通是由车辆、通信信号、供电、工务、运营管理等专业子系统组成的复杂系统,该系统的安全保证需要运用系统工程和安全工程的理论和方法建立起有效的管理体系。在国标《风险管理-风险评估技术》(GB/T 27921—2011)中对系统安全技术给出了明确要求,系统安全工作包括风险源识别、系统安全分析、风险性评价及风险控制等一系列内容。

轨道交通安全评价的概念来自 EN 5012X 系列欧洲铁路标准。我国在 2007 年颁布了国标《地铁运营安全评价标准》(GB/T 50438—2007,于 2018 年废止),该标准中运营安全评价的范围不只限于信号系统,还包括安全管理及事故风险评价、运营组织与管理评价、车辆系统评价、通信系统评价、供电系统评价、线路轨道土建结构及安全保护区评价、机电设备评价,涵盖了城市轨道交通所有专业系统。2018 年交通运输部颁布《城市轨道交通运营管理规定》,其中明确规定“城市轨道交通运营主管部门应当对运营单位运营安全管理工作进行监督检查,定期委托第三方机构组织专家开展运营期间安全评估工作”。同年,交通运输部还颁布了《城市轨道交通正式运营前和运营期间安全评估管理暂行办法》《城市轨道交通运营期间安全评估规范》《城市轨道交通风险分级管控和隐患排查治理管理办法》等一系列行业监管的规范性文件,为城市轨道交通行业在运营安全管理中开展第三方评估提供了依据。

上海市是国内最早开展城市轨道交通运营安全评估的城市之一。2011 年上海市颁布了《上海市城市轨道交通运营安全评价管理试行办法》,办法中规定“每条独立的城市轨道交通运营线路(包括延伸线和支线)自载客试运营开始,运营时间 10 年以下的线路每 5 年进行一次运营安全评价;运营时间 10 年以上的线路每 3 年进行一次运营安全评价。对于存在安全隐患的线路,可根据问题涉及的专业范围实施专项安全评价”。文件也明确了评价方法是:轨道交通安全评价采用委托第三方组织专家评价和企业自我评价相结合的方式,对城市轨道交通运营系统中存在的风险进行分析,为制定城市轨道交通运营安全对策措施以及运营安全监督提供科学依据。同时,上海市制定了《上海城市轨道交通运营安全评价细则》。

自 2011 年 10 月以来,太平洋保险集团受上海市建设交通委的委托,在市建设交通委、市交通运输与港口管理局、申通地铁集团等政府主管部门和运营企业的积极推进和主动配合下,成立了第三方评估专家组,经过 7 个多月的共同努力,完成了上海城市轨道交通网络运营安全评估项目,评估范围覆盖轨道交通全网络和全生命周期;评估采用定性定量结合、实际演练等方法,体现了第三方安全评估的专业性、公正性、创新性。太平洋保险集团因此获得了“2012 年度上海市金融创新成果一等奖”。这是上海开展城市轨道交通第三方安全评估的初步尝试。

2012 年下半年,由上海市交通运输与港口管理局组织同济大学等单位实施了上海轨道交通 1 号线运营安全评价工作,开创了我国轨道交通运营线路逐条实施安全评价的先河。截止 2021 年底,上海已累计完成 12 条运营线路共 25 次的运营安全评价工作;其中 10 条线路已完成两轮运营安全评价,2 条线路已完成三轮运营安全评价。自 2019 年起,上海在每年开展线路运营安全评价的同时,还同步开展城市轨道交通线网运营期间安全评估。通过运营安全评价,共识别出运营安全风险点 900 多个,风险点按其来源又分为设计标准差异、设施设备老化伤损、管理问题、接口问题、其它 5 类,再针对风险源的不同情况提出整改对策和建议共 1 400 多条,有效保障了上海市轨道交通网络运营的总体安全。

上海 10 年的实践表明,第三方评估模式是科学评估城市轨道交通运营条件和能力的有效途径,也是保障安全运营的重要抓手。第三方安全评估进一步推动了轨道交通行业风险管控和隐患排查的机制建设和规范化实施,为轨道交通主管部门和运营方提供了安全管理的决策依据。

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## Commentary

**Third Party Evaluation of Urban Rail Transit Operation Safety***ZHOU Huai*

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With the development of urbanization, ensuring urban rail transit operation safety has become a crucial part of operation management. Urban rail transit is a complex system consists of professional subsystems including vehicle, communication signal, power supply, work, operation management. Theory and methodology of system engineering and safety engineering are required to build effective management system. It is clearly defined in national standard Risk management — Risk assessment techniques (GB/T 27912—2011) that system safety work includes a series of content such as risk source recognition, system safety analysis, risk assessment and risk control.

The concept of rail transit safety evaluation comes from EN railway standards EN 5012X series. In Standard for the operation safety assessment of existing metro (GB/T 50438—2007, abolished in 2018), other than signaling system, operation safety evaluation also covers assessment of safety management and accident risk, operation organization and management, vehicle system, communication system, power supply, line track civil engineering structure and safe zone, electromechanical equipment, and all other urban rail transit professional systems. In Regulations on urban rail transit operation management issued by Ministry of Transport in 2018, it is clearly written that urban rail transit operation head management should plan inspection on operation unit safety management work and recruit third party institute specialists for the evaluation during operation regularly. In the same year, Ministry of Transport also issued industry supervision regulation documents, Interim measures on safety assessment management before and during official operation of urban rail transit, Regulation on urban rail transit safety assessment during operation, Measures on urban rail transit troubleshooting and governance of risk classification management and control and hazard, providing reference for the third party.

Shanghai is one of the first cities carrying out urban rail transit operation safety evaluation in China. In 2011, Shanghai issued Trial measures on Shanghai urban rail transit operation safety evaluation management, which regulated that for each independent urban rail transit operation line (including extension line and branch line), safety assessment should carry out every five years for lines with operation time under 10 years, starting from the trial operation with passenger; for lines over 10 years, it is required for every three years. For lines with safety hazards, specialized assessment should be implemented targeting problems involved professionally. The document also clarified that the assessment method is combining third party specialist evaluation and enterprise self-evaluation. Existing risks in the system are analyzed to provide scientific reference for formulating the safety measures and supervision strategies. Meanwhile, Shanghai formulated Shanghai urban rail transit operation safety evaluation details.

Since October 2011, CPIC has initiated a third party specialist group under guidance of Shanghai Construction and Transport Commission, with proactive support from government and enterprises including the Commission itself, Shanghai Transportation and Harbor Management Bureau, Shentong Metro Group. After mutual effort of more than 7 months, Shanghai rail transit network operation safety evaluation project is completed, assessment range covers rail transit full network and full life cycle. The assessment adopts means including combination of qualitative and quantitative method and practical drill, presenting professional, impartial and innovative features of third party safety assessment. CPIC was awarded first prize in Shanghai Financial Innovation Creation 2012. This is the preliminary attempt of Shanghai carrying out third party safety assessment.

In the second half of 2012, Shanghai Rail Transit Line 1 operation safety evaluation was implemented by Tongji University and other units under guidance of Shanghai Transportation and Harbor Management Bureau, opening the curtain of line by line operation safety evaluation in China. By the end of 2021, Shanghai has completed 25 times of operation safety evaluation for 12 operating lines, of which 10 lines have completed 2 rounds and 2 lines with 3 rounds. Since 2019, network safety assessment during operation has been carried out simultaneously with line evaluation. Over 900 safety risks are spotted and are categorized in 5 source types of design standard difference, facility and equipment aging and damage, management issue, interface issue, others. Over 1400 rectification countermeasures and suggestions are listed targeting individual conditions. The overall safety of the network operation is well guaranteed.

The practice of Shanghai over the past 10 years has proven that third party evaluation mode is an effective and scientific approach to assess conditions and abilities of urban rail transit safety operation, as well as an important grasp of ensuring it. Third party evaluation further promotes construction and regulated implementation of rail transit industry risk management and control and hazard inspection mechanism, giving foundation to lean on for rail transit head management and operation unit in safety management decision-making.

**Translated by ZHANG liman**