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Expert Review of Metro Escalators Safety

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Abstract

Upon outspending of the service term by metro tunnel escalators, it is important to determine the degree of escalators wear and the term of remaining life. To ensure safety of metro tunnel escalators in such cities as Moscow and St. Petersburg it is required to assess the technical condition of escalators outspent their standard service term for potential extension of their service term until they are replaced. The article considers the methods for such assessment, the experience of its application and new methods for monitoring of the technical condition of operated escalators.

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Keywords: metro; tunnel escalators; safety; expert review; technical condition monitoring; vibration control.

1. Introduction

St. Petersburg metro, the second in terms of age and development in Russia, is the most important kind of public transport carrying more than 2.4 mln passengers daily. The first line was commissioned in 1955. The peculiarity of St. Petersburg metro is the deep level of the majority of stations (up to 70 m) associated with the city's geological conditions.

In this context, of great importance is reliability and safety of escalators bringing passengers to train platforms and back to the ground. Unlike floor-by-floor escalators used in buildings of various purposes, tunnel escalators

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have essentially high ascend, significantly higher intensity of passenger flows and are located in inclined tunnels which impairs their accessibility for service and repair and complicates the process of evacuating the passengers in case of an escalator failure.

2. Main text

The operational conditions of metro escalators are stipulated by heavy duty mode of their work, presupposing 18–20 hours of work per day with continuous operation during the year. In rush hours the escalators capacity is overloaded. In St. Petersburg metro 255 escalators of 16 kinds are operated carrying about 5 mln. passengers daily; the bulk of escalators are machines with ascend height exceeding 30 m.

Thereby, the first stations escalators EM-4 and LT-1 served out the time ranging from 54 to 59 years having the standard service term 50 years and underwent on the average 9 overhauls each; the escalators LT-2 and LT-3 installed at the stations of successive lines served out the time ranging from 39 to 53 years having the standard service term 50 years and underwent on the average 7 overhauls each. Newer escalators ET-2 served out the time ranging from 29 to 36 years but their standard service term is 30 years. For the whole of the city, more than 80 escalators served out their service term and are either to be replaced or inspected for substantiating the extension of their service term and release to further service.

Replacement of escalators is rather an expensive and labor consuming process, for the city does not have the means and resources for timely replacement of all the operated escalators which served out their service term, moreover, the escalators are to be replaced with the passengers access lock and, as the majority of stations are provided with one exit only, in this case it is necessary to close a station for rather a long time.

The second problem associated with escalators replacement relates to the requirement of SP 32-105-2004 “Metro” associated with passengers’ safety stating the installation of four escalators upon the availability of one station entrance and four escalators on one of the entrances upon the availability of two entrances. Inasmuch as the inclined tunnel diameter was calculated for the installation of three escalators of traditional structure, it is rather difficult to install four machines in existing tunnels for replacement. In this case, the exit from the tension station may enter the passengers’ area, and the necessity occurs for only partial escalators service or full service from the passengers’ area which decreases the safety level.

Currently in the Russian Federation there are two applicable documents determining the requirements to escalators safety: Federal Codes and Rules “Safety rules for metro escalators” (FCS) and State Standard GOST R 54765-2011 “Escalators and passenger conveyors. The requirements to the safety of a unit and its installation” which is the analog of EN 115-1:2010. The first document is mandatory; the second document is advisory on grounds that the escalators are not on the list of Technical Regulations of the Customs Union TRCU 010/2011. These documents fit together in many requirements to escalators and their installation but also have substantial differences which in a series of cases complicate the process of replacement of outspent escalators with new models and placing four machines in the inclined tunnel in the course of reconstruction or technical upgrading of stations.

The authors have rather an extensive experience in escalators structure expert review from the position of conformity to safety requirements of the individual elements associated with escalators operation safety as well as experience in escalators installation. Currently, as per Federal Law 116-FZ “On Industrial Safety of Hazardous Production Facilities” as rev. 22-FZ, for escalators service release an expert review as to the conformity to FCS requirements is to be performed and registered with Rostekhnadzor. Standard GOST R 54765-2011 is on the list of Technical Regulations of the Customs Union 010/2011; however, tunnel escalators are not on the list of equipment covered by such regulations. The expertise considers the standard requirements, but the main requirements are those of FCS.

As far as the conditions of escalators installation differ from station to station including the ascend value, the number of machines, escalators entrance and exit conditions, an expert review is to consider safety requirements not only to a structure but to escalators installation as well i.e. to consider the totality set consisting of the machines and a structure (a tunnel) first in terms of safety of passengers carried by the station escalators. Such expert review