

Chapter IV

Operation and Maintenance

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Brief snapshot of the chapter:

- The firm M/s G4S Secure Solutions was appointed for security arrangements at the Metro stations on direct negotiation basis without tendering and without any recorded justification as to why this particular security firm was selected, violating the CVC guidelines (May 2006) and General Financial Rules, 2005.
- A certified cyber security agency for routine Vulnerability Assessment and Penetration Testing (VAPT) was not empanelled to examine the security thus, the metro system was always susceptible to threat and malfunction.
- The hardness value of rail samples was less as compared to the Indian Railway Standard specification which may lead to higher rate of wear and tear of the rail reducing the rail life.
- The Company did not determine any benchmark for maintaining noise level within the permissible limit. Thus, the goal for providing comfortable environment inside the Metro trains and outside at the stations was not achieved.

The Company follows a mix approach for operation and maintenance where the core operation and maintenance of major assets are done in-house with the regular staff specially recruited and trained for this purpose. The non-core and offline activities³⁷ are generally outsourced though some of them are managed in-house.

Audit reviewed the operational efficiency of the Company and findings thereof have been brought out in the succeeding paragraphs.

4.1 Irregular appointment of private security firm

Central Vigilance Commission (CVC) guidelines (May 2006) provide that the preferred mode of awarding contracts is through open competitive bidding. Further, Rule 181 of the General Financial Rules (GFR), 2005 provided that the Ministry or Department should issue advertised tender enquiry for estimated value of works or service above ₹ 10 lakh. Rule 184 of the GFR, 2005 provided that in case of outsourcing by choice, detailed justification including the circumstances leading to such choice should be recorded.

The Company decided³⁸ (June 2016) to appoint M/s G4S Secure Solutions (G4S) for security arrangements on direct negotiation basis to set the right systems in place from beginning. A contract for guarding services was entered (September 2016) between M/s G4S and the Company for three years which was continuing till March 2023. The initial monthly cost to be paid to M/s G4S was ₹ 32.72 lakh.

³⁷ Housekeeping, maintenance of office building, etc.

³⁸ Board of Directors (BoD) of the Company in its 25th meeting (June 2016).

The Board of Directors (BoD) did not resort to open tendering process for engagement of security personnel and awarded the contract to M/s G4S on nomination basis without any recorded justification as to why this particular security firm was selected. This was in violation of the CVC guidelines and provisions of GFR. The contract was renewed thereafter and payment of ₹ 76.04 crore was made to the contractor G4S during the period November 2016 to March 2022.

In reply, the State Government stated (September 2024) that Metro security in India is considered highly critical and all metros are having airport like security in line with categorisation specified by Intelligence Bureau (IB). In view of extremely high cost of security by CISF, it was decided to go for hybrid model of security for the first time in country, where crucial security will be managed by U.P. Police and assistance will be provided by private security. There is past history of assisting CISF at DMRC or airport security. On the basis of above, Lucknow metro had entered into a contract with G4S Secure Solution (I) Limited. Over the period, with maturity of private security agencies in recent time with large number of agencies assisting at airport security and implementation of the Private Security Agencies (Regulation) Act, 2005, Lucknow metro has also appointed a new security contractor through open tender process since March 2023.

The reply was not acceptable. The contract should have been executed through open tendering by following the Rules and CVC guidelines keeping in view the security service requirements. Moreover, there was no recorded justification as to why the particular security firm M/s G4S was selected in September 2016. Thus, propriety rules were completely ignored. Responsibility needs to be fixed.

4.2 Technical evaluation by the IIT, Kanpur

During the course of audit various construction contracts and contracts related to track installation, signalling, rolling stock, noise and vibration, etc. were studied. To evaluate the technical parameter and issues related to these contracts, identified by the Audit, IIT, Kanpur was engaged. IIT, Kanpur examined these issues, and the findings thereof are discussed in the following paragraphs.

4.2.1 Vulnerability of the CBTCS to malfunction

Communication Based Train Control (CBTC) system utilizes telecommunications between trackside equipment and trains to optimize track space utilization. CBTC system represents a new era in real-time train transit control, offering benefits such as reduced maintenance costs, increased flexibility, and enhanced interoperability with centralized control system. By employing a moving block system, CBTC system enables trains to operate in closer proximity, allowing for a higher frequency of train movements without compromising safety. This system can dynamically adjust train speeds to prevent congestion and recover from delays, resulting in smoother rides and energy savings.

IIT, Kanpur, while assessing vulnerability of the CBTC system to interference and jamming, observed that currently, the security was being examined by Intelligence Bureau only. As a standard practice, it was necessary to empanel a certified cyber security agency for routine Vulnerability Assessment and Penetration Testing (VAPT) and generate security audit reports. IIT, Kanpur specified that without VAPT, the system was susceptible to threat and malfunction which may lead to immediate shutdown of the entire metro system. If such downtime occurs during working hours, it may be difficult to remedy.

In reply, the State Government stated (September 2024) that CBTC System was stand-alone proven system across the globe and designed on failsafe principle. The CBTC System provided by M/s Alstom was internationally approved and was in use in various metros globally. VAPT is a new concept and same has not been incorporated by any other metro in India till now. No such testing is known so far at any metro. Considering the global scenarios on cyber security, the Company itself has taken lead to initiate the VAPT to ensure the security of the CBTC System at large.

4.2.2 Quality issues of rails of Rolling Stock

As per Indian Railway Standards IRS-T-12-2009, Hardness value of rail should not be less than 260 BHN for HH 880 rail head (Depot area) and hardness value should be in the range of 340-390 BHN for HH 1080 (main Line).

Hardness testing was carried out by the IIT Kanpur at Advance Centre for Materials Science (ACMS), Material Testing Laboratory of IIT, Kanpur by using Universal Hardness Testing Machine FH-10; Tinius-Olsen Ltd. The tests were carried out for three times on each sample provided by the Company. The test on both rails revealed following results:

SAIL 880	Nippon 1080
At 31.25 Kgf, 229.07 BHN	At 31.25 Kgf, 291.78 BHN
At 62.5 Kgf, 242.52 BHN	At 62.5 Kgf, 308.79 BHN

(Note: Dwell time (duration) for each test was 10 Second)

IIT, Kanpur observed that for both the samples, the hardness value was less as compared to the Indian Railway Standard Specification. Actual hardness values measured were in the range of 229.07 to 242.52 BHN (Depot area) and 291.78 to 308.79 BHN (main Line). This indicates that the Company has used rails of relatively less hardness. This may result in increased maintenance cost for the Company due to decreased life of rails and wheels.

The State Government stated (September 2024) that Brinell Hardness test was required to be carried out as per Clause 19 of IRS-T-12-2009 (including ACS 1 to 5) and IS:1500. As per table- 2 and 3 of IS: 1500, Force-diameter ratio should be 30 and load to be applied should be 187.5 Kgf for 2.5 mm ball diameter. But, the load applied on samples by IIT, Kanpur is 1/6th and 1/3rd of the standard load to be applied as per the provision of “Method for Brinell Hardness Test for Metallic Materials” (IS:1500). Thus, the tests have not been conducted in accordance with prescribed codal provisions. Tests earlier carried out during procurement demonstrated that the hardness measured satisfied the provisions enumerated in “IRS-T-12-2009”.

In response, IIT, Kanpur showed its disagreement with the State Government reply and stated that the technical team of IIT, Kanpur had reviewed the earlier submitted test report to the Company and found that testing procedures were as per the standards (IS 1500:2005). IIT, Kanpur has followed the Force-Diameter Ratio Table and accordingly modified the applied load as per the code. This is a standard practice.

IIT, Kanpur did the hardness tests as follows:

SAIL 880	Nippon 1080
At 5 mm indenter and 750 Kgf, 226 BHN	At 5 mm indenter and 750 Kgf, 254 BHN
At 10 mm indenter and 3000 Kgf, 241 BHN	At 10 mm indenter and 3000 Kgf, 270 BHN

In this context it was noted that the comment that “load applied on samples is 1/6th and 1/3rd of the standard load to be applied” was misleading. The IS:1500 standard requires the test to maintain a specific Force-Diameter ratio. IIT, Kanpur had conducted repeated test and stated that the smaller value of hardness than recommended obtained from the repeated experiments indicate there may be higher rate of wear and tear of the rail which will reduce the rail life faster. Further, if the wheel hardness does not match with the rail hardness, there would be possibility of the wheel deformation which will affect the stability of the rolling stocks.

4.2.3 Noise level found higher than the permissible limits

For conducting tests for measurement of noise level inside and outside the trains, IIT, Kanpur reported that the Guidelines and Principles for the Design of Rapid Transit Facilities (1973) issued by the Institute for Rapid Transit, Washington DC stipulates that to ensure passenger comfort, the sound level should remain in the range of the permissible limit 65 dB to 75 dB during the normal operation at specified speeds. As per the guidelines, the main goal of the rapid transit system was to control noise and vibration by providing system patrons with an acoustically comfortable environment through maintaining noise levels in vehicles and stations within the acceptable limits.

To measure the noise levels within the metro and at the platform for ensuring passenger’s comfort, the technical team of IIT, Kanpur conducted tests at a uniform metro speed of 40 kmph at different tracks (elevated and tunnels). IIT, Kanpur found that by and large the sound intensity was not very high, yet they were generally higher dB than the internationally accepted sound level as detailed in *table-4.1 below*:

Table-4.1

Position of test results of noise of metro vis-à-vis accepted level

Sl. No.	Name/place of metro station	Elevated/ Under ground Station	Test condition (Static/ Dynamic)	(Interior/ Exterior) of Metro	Accepted level of noise (in dB)	Test result found by IIT, Kanpur (in dB) (Max. & Min.)
1	Munshipulia	Elevated	Static & door open	Interior	65	76.1 to 74.9
2	Munshipulia	Elevated	Static & door closing	Interior	65	76.2 to 73.5
3	Munshipulia to KD Singh Babu Stadium	Elevated	Dynamic	Interior	75	83.4 to 62.4
4	Munshipulia	Elevated	Static& door open	Exterior	60	81.7 to 80.0
5	Munshipulia	Elevated	Metro leaving from platform	Exterior	75	82.4 to 79.4
6	Hazratganj	Under ground	Static	Exterior	67	81.3 to 78.0

(Source: Test report of IIT, Kanpur)

As evident from table above, in static condition of metro, interior noise level was measured at *Munshipulia* stations inside the Metro train where the test result was found higher ranging from 76.1 dB to 76.2 dB against the internationally best practices adopted value of 65 dB. The interior noise level was also measured inside the metro on dynamic condition on elevated and tunnel stations³⁹ where test results found higher 83.4 dB against the internationally best practices adopted value of 75 dB from *Munshipulia* to *KD Singh Babu Stadium*. Similarly, exterior noise tests were conducted at seven places⁴⁰ for measurement of exterior noise. The test result on static and leaving conditions of Metro was found higher at 81.7 to 82.4 dB against the internationally best practices adopted value of 60 dB to 75 dB respectively. In one out of four places selected⁴¹ for measurement of noise level on exterior of metro, the test result found higher 81.3 dB against the permissible limit of 67 dB at stationery condition. All tests were carried out during non-revenue hours⁴² on the request of Metro Authorities to minimize external noise factors.

In reply, State Government stated (September 2024) that the “Guidelines and Principles for the Design of Rapid Transit Facilities” issued by “Institute for Rapid Transit”, Washington, D.C. is not a Standard and is only a guideline. These guidelines acknowledge that it is impossible to set a universal standard applicable to all transit systems and that each transit system is governed by its own authorising statutes and regulations. Consequently, these guidelines are not binding to the rolling stock of Lucknow Metro.

³⁹ From Munshi Pulia to KD Singh Babu Stadium station and KD Singh Babu Stadium station to Hazratganj station.

⁴⁰ Three places at Munshi Pulia Metro station and four places at Hazratganj underground Metro Station.

⁴¹ At underground station Hazratganj.

⁴² Metro not available for general public.

The reply may be seen in view of the fact that the guidelines and principles issued by the 'Institute' recommended for acceptance of the best practice for design and construction of new rapid transit systems. Moreover, the Company did not determine any benchmark for maintaining noise level within the permissible limit. Thus, the goals for providing comfortable environment inside the Metro trains and outside the stations was not fully achieved.

4.3 Interim Speed Certificate for operation of rolling stock not renewed

As per point no. 8.6 of the Interim Speed Certificate (ISC) for operation of rolling stock over N-S Corridor, the certificate shall be valid for a maximum period of five years from the date of issue. In case Final Speed Certificate is not issued during this period, the Company shall approach Research Designs & Standards Organisation (RDSO) sufficiently in advance for extension of validity of this Interim Speed Certificate.

Audit noticed that the ISC was not renewed despite expiry of five years from the date of issue of the ISC (March 2017). In absence of non-renewal of ISC, wear and tear in wheel of rolling stock and adjustment needed thereof could not be ascertained. Thus, by not renewing the Speed Certificate after expiry of five years, the Company has taken unnecessary risk with the safety of passengers.

In reply, the State Government stated (September 2024) that as per Procedure for Safety Certification and Technical Clearance of Metro System (PSTM)-2015, Interim Speed Certificate (ISC) shall remain valid till the issuance of the final speed certificate (to assess the riding quality & stability with worn-out wheels and rails) as no extension provision of ISC (such as 5 years) is defined.

The reply was not factual because the PSTM-2015 does not state that ISC shall remain valid till the issuance of the Final Speed Certificate. Therefore, ISC issued to Lucknow metro was valid only for five years as specifically mentioned in ISC. This implies that the Company was supposed to reach out to the RDSO for the renewal of the certificate.

4.4 Office building not insured

A tenancy lease deed was executed (October 2015) between *the Smarakon, Sangrahalayon, Sansthao, Paarkon Va Upvano Aadi Ki Prabandhan Suraksha Evam Anurakshan Samiti* (Society) and the Company for taking at lease the Administrative Building of *Dr. BR Ambedkar Samajik Parivartan Sthal* to establish corporate office of the Company.

Clause 2(k) of the deed provided that the Company would keep the building insured in the joint names of the Society and the Company against loss or damage by fire on a sum equivalent to the cost of building with leading National Insurance Company. Whenever during the said term, the said building or any part thereof respectively is destroyed or damaged whether by fire or hurricane or earthquake or riots or otherwise, the Company would reinstate and rebuild the same to the satisfaction of the Society /GoUP.

However, the Company did not carry out insurance of the building, thus, resulting in violation of terms of the deed which was open to risk and liability in case of damages to the building.

In reply, the State Government accepted (September 2024) the facts and stated that the management of the Company has decided to get the building insured from leading National Insurance Company in the joint names of the Society and the Company.

4.5 Conclusion

There were deficiencies in operation and maintenance. Private security firm was appointed on nomination basis in violation of the provisions of the CVC Guidelines and GFR. Security of CBTC system was not examined from a certified cyber security agency for routine Vulnerability Assessment and Penetration Testing. Company used rails of less hardness. Interim speed certificate was not renewed after expiry. The Company did not get rented office building insured making it open to risk and liability in case of damages to the building.

4.6 Recommendations

6. *The Company should ensure full compliance with the statutory provisions, rules, Central Vigilance Commission guidelines, Indian Railway Standards/specifications, agreements, etc.*
7. *The Company should empanel a certified cyber security agency for routine vulnerability assessment and penetration testing to avoid susceptible threat and malfunctioning of the communication based train control system.*

