GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

LOK SABHA
UNSTARRED QUESTION NO. 4287
TO BE ANSWERED ON 18.03.2026

IMPLEMENTATION OF KAVACH 4.0 AND AI BASED RAIL SECURITY INFRASTRUCTURES

†4287. SMT. ANITA NAGARSINGH CHOUHAN:

Will the Minister of RAILWAYS be pleased to state:

(a) whether Kavach 4.0 and Artificial Intelligence (AI) based railway safety infrastructure are being implemented by the Indian Railways with the objective of preventing train accidents, enhancing the safety of train operations and minimizing human errors and if so, the key technical provisions and features thereof;

(b) the number of railway routes, stations and locomotives in the country where Kavach system, AI-based signalling, track monitoring and anti-collision systems have been installed so far, along with the targets set for the next two years; and

(c) whether there is any proposal under consideration of the Railways to implement Kavach 4.0 on a priority basis in highly accident-prone areas, congested routes and level crossings and to provide training to the concerned staff and if so, the details thereof?

ANSWER

MINISTER OF RAILWAYS, INFORMATION & BROADCASTING AND ELECTRONICS & INFORMATION TECHNOLOGY

(SHRI ASHWINI VAISHNAW)

(a) to (c): 1. Kavach is an indigenously developed Automatic Train Protection (ATP) system. Kavach is a highly technology intensive system, which requires safety certification of highest order (SIL-4).

2. Kavach aids the Loco Pilot in running of trains within specified speed limits by automatic application of brakes in case Loco Pilot fails to do so and also helps the trains to run safely during inclement weather.

§

3. **The first field trials on the passenger trains were started in February 2016. Based on the experience gained and Independent Safety Assessment of the system by Independent Safety Assessor (ISA), three firms were approved in 2018-19, for supply of Kavach Ver 3.2.**

4. **Kavach was adopted as National ATP system in July, 2020.**

5. **Implementation of Kavach System involves following Key Activities:**

   a. **Installation of Station Kavach at each and every station, block section.**
   b. **Installation of RFID Tags throughout the track length.**
   c. **Installation of telecom Towers throughout the section.**
   d. **Laying of Optical Fibre Cable along the track.**
   e. **Provision of Loco Kavach on each and every Locomotive running on Indian Railways.**

6. **Based on deployment of Kavach version 3.2 on 1465 RKm on South Central Railway and experience gained, further improvements were made. Finally, Kavach specification version 4.0 was approved by RDSO on 16.07.2024.**

7. **Kavach version 4.0 covers all the major features required for the diverse railway network. This is a significant milestone in safety for Indian Railways. Within a short period, IR has developed, tested and started deploying Automatic Train Protection System.**

8. **Major improvement in Version 4.0 includes increased Location Accuracy, Improved Information of Signal Aspects in bigger yards, Station to Station Kavach interface on OFC and Direct Interface to existing Electronic Interlocking System. With these improvements, Kavach Ver.4.0. is planned for large scale deployment over Indian Railways.**

9. **After extensive and elaborate trials, Kavach Version 4.0 has been successfully commissioned on 1452 Route Kilometres, covering the high density Delhi- Mumbai and Delhi-Howrah routes as below:**

SN	Section	Progress (Route Km)
(1)	Delhi-Mumbai route:	
i	Junction cabin – Palwal – Mathura –Nagda section	667
ii	Vadodara - Ahmedabad section	96
iii	Vadodara - Virar section	336
(2)	Delhi – Howrah route:	
i	Gaya Sarmatanr section	93
ii	Chota Ambana - Bardhaman – Howrah section	260

10. **Further, track side Kavach implementation work has been taken up on 24,427 RKM covering all GQ,GD,HDN and identified sections of Indian Railways.**

11. **Progress of key items of Kavach on High density routes including Delhi– Mumbai & Delhi– Howrah corridors as on 14.03.2026 are as under:**

SN	Item	Progress
i	Laying of Optical Fibre Cable	8570 Km
ii	Installation of Telecom Towers	1100 nos
iii	Station Data Centre	767 Station
iv	Installation of Track side equipment	6776 RKm
v	Provision of Kavach in Loco	4211 nos

12. **The sections mentioned above also includes sections which pass through Gonda District.**

13. **In addition, work for installation of Kavach in 8979 Locomotives and 1200 EMU/MEMU has been taken up.**

14. **Specialized training programmes on Kavach are being conducted at centralized training institutes of Indian Railways to impart training to all concerned officials. By now more than 55,000 technicians, operators and engineers have been trained on Kavach technology. This includes about 47,500 Loco Pilots & Assistant Loco Pilots. Courses have been designed in collaboration with IRISET.**

15. **The cost for provision of Track Side including Station equipment of Kavach is approximately Rs. 50 Lakhs/Km and cost for provision of Kavach equipment on locomotives is approximately Rs. 80 Lakh/Loco.**

16. **The funds utilized on Kavach works so far up to Feb'26 is Rs. 2,763.90 Crores. The allocation of funds during the year 2025-26 is Rs. 1673.19 Crores. Requisite funds are made available as per the progress of works.**

<u>Technological Improvements:</u>

Technological improvement in Indian Railways (IR) is a continuous process. Some major technologies deployed/piloted over IR are as follows:

Machine Vision Inspection System (MVIS): MVIS is an Artificial Intelligence (AI)/ Machine Learning (ML) based system which generates alert on detecting any hanging, loose or missing components of moving trains.

Three (03) MVIS have been installed in Northeast Frontier Railway, two (02) in Dedicated Freight Corridor Corporation of India Limited (DFCCIL) and one (01) in South East Central Railway on pilot basis for freight stock. Further, a MoU has been signed between IR and DFCCIL to induct four (04) MVIS over IR network for freight stock.

Also, Research Designs and Standards Organisation (RDSO) has taken up development of MVIS for rolling stock in collaboration with industry through an Expression of Interest (EoI).

Wheel Impact Load Detector (WILD): WILD is a way-side inspection system that measures the impact of wheel on track to identify the defective wheel in Rolling Stock. 24 such systems are installed over IR.

Online Monitoring of Rolling Stock (OMRS): OMRS is a way-side inspection system which monitors the health of bearing & wheel of Rolling Stock. 25 such systems are installed over IR out of which one (01) OMRS is installed at Sirpur Kaghaz nagar /Secunderabad Division in South Central Railway.

Integrated Track Monitoring Systems (ITMS): ITMS are deployed for comprehensive inspection and monitoring of Railway tracks. The ITMS utilizes machine learning and image processing to monitor and detect defects in railway track components such as rails, sleepers, and fastenings. The data from ITMS is analysed for urgent and planned maintenance of track. Presently three (03) ITMS are deployed for track recording and monitoring of IR track. It helps in better track maintenance planning, enhanced safety, improved reliability of track assets and operational efficiency.

Intrusion Detection System (IDS): Artificial Intelligence (AI) enabled Intrusion Detection System (IDS) using Distributed Acoustic System (DAS) is implemented in 141 RKms section of Northeast Frontier Railway for detecting presence of elephants on Railway tracks. The system is designed to generate alerts for loco pilots, station masters and Control Room about the movement of elephants in proximity of railway tracks, for taking preventive action timely.

Drone based monitoring of Overhead Equipment: Drone based monitoring with thermal imaging of Overhead Equipment (OHE) has been taken up in Raipur division on pilot basis. Further, IR in association with IIT Madras, has taken up development of a Drone based aerial inspection of Overhead Equipment (OHE) which will also analyse the captured data using AI/ML.

TRI-Netra: RDSO has taken up development of TRI-Netra (Terrain Imaging for Locomotive Drivers - Infra-Red, Enhanced Optical & Ranging Device Assisted) for assisting the Loco pilots during foggy, rainy and inclement weather. This system comprises of optical camera, infra-red camera and ranging devices (e.g. Radar/Lidar) & AI to create a real-time, enhanced vision system for assisting Loco pilots.

Rail Madad and Passenger Reservation System: For improving operational efficiency, AI/ML models have been implemented in the areas of passenger services (Rail Madad and Passenger Reservation System), freight operations (prediction of estimated time of arrival of freight trains), and prediction of unloading/loading time.

Pilot initiatives involving Artificial Intelligence/Machine Learning (AI/ML) driven predictive maintenance of Signalling system is being undertaken over Indian Railways. At some of the stations it has been used to evaluate efficacy of maintenance. Measurable outcome includes limited Prediction Logics and Alerts mechanism.

Automatic Wheel Profile Measurement System (AWPMS): A Memorandum of Understanding has been signed between IR and Delhi Metro Rail Corporation to induct 4 numbers of AWPMS. The AWPMS allows for automatic non-contact measurement of train wheel profile ensuring real-time measurement of wheel geometry and wear. The locations identified for installation of these 4 systems are as follows:

a. **Lokmanya Tilak Terminus Coaching Depot over Mumbai Division of Central Railway**
b. **Anand Vihar Terminal Coaching Depot over Delhi Division of Northern Railway**
c. **Near TughlakabadWagon Depot over Delhi Division of Northern Railway**
d. **Near Pandit Deen Dayal Upadhyay Wagon Depot over Pandit Deen Dayal Upadhyay Division of East Central Railway**

Centre for Railway Information Systems has signed a Memorandum of Understanding with Digital India Bhashini Division for auto language translation for handling of user complaints in any of the 13 scheduled languages.

Centre for Railway Information Systems has signed a Memorandum of Understanding with Indian Institute of Technology Delhi for enhancing efficiencies in the area of train operations.

Centre for Railway Information Systems has signed a Memorandum of Understanding with Indian Institute of Technology Mumbai for adoption of generative AI in transportation and related sectors.

Training / Skill Development:

Indian Railways have taken several measures to enhance work productivity, motivation and professional competencies of railway employees through structured capacity building and advanced training. Capacity building and skill upgradation are continuous and institutionalised processes supported by a well-established training framework across Indian Railways.

Indian Railways have developed a comprehensive training ecosystem providing training interventions at various stages of the career to ensure skilling, re-skilling and up-skilling of employees. For this purpose, extensive training infrastructure has been created in the form of Centralised Training Institutes (CTIs), Multi-disciplinary Zonal Training Institutes (MDZTIs), Multi-disciplinary Divisional Training Institutes (MDDTIs) and specialised training centres, which conduct induction, refresher, promotional and technical training programmes at different stages of service.

Training modules are designed to strengthen employees' competencies and equip railway personnel with the skills required for modern, technology-intensive railway operations. These modules are also

periodically updated to incorporate new technologies in railway operations and maintenance.

Specialised initiatives such as the Centre of Excellence on Kavach at IRISET, courses on emerging technologies (including Data Science, AI applications, Big Data Analytics, Block chain, and Cloud Computing, etc.) in collaboration with C-DAC, and Mission Rail Karmayogi for behavioural and service-orientation training of frontline staff further contribute to improving productivity and efficiency. Employees are also encouraged to undertake online learning through digital platforms such as the iGOT Karmayogi portal for continuous up-skilling and re-skilling.

In addition, motivational and wellness initiatives, including yoga sessions, physical fitness activities and stress-management programmes during training and at workplaces, are promoted to enhance employee well-being and morale.

****