



भारत सरकार – रेल मंत्रालय
Govt. Of India – Ministry of Railways
अनुसंधान अभिकल्प एवं मानक संगठन
लखनऊ – 226011
Research Designs & Standards Organization
Lucknow-226011



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No.: [RDSO-SIG0TCAS\(RB\)/1/2022](#)

Dated: 06.05.2025

1.	Medha Servo Drives Pvt. Ltd., P-4/5B, Industrial Park, IDA Nacharam, Hyderabad-500076.
2.	Kernex Microsystems (India) Ltd., Plot No.38 to 41, Hardware Technology Park, Maheswaram Mandal, R.R.(Dist), Hyderabad, Telegana-501510.
3.	HBL Power Systems Limited, 8-2-601, Road No.10, Banjara Hills, Hyderabad-500034.
4.	G.G.Trionics India Private Limited, PLOT NO 10, 3rd Phase,6th Main Peenya Industrial Area Bangalore, Karnataka- 560058.
5.	Quadrant Future Tek Limited, Village-Basma OnBasma, Jhajjon Road Distt-Mohali Punjab-140417.
6.	Areca Embedded Systems Private Limited, Plot No.5B, Sy. No.184-185, Phase-V, IDA Cherlapally Hyderabad-500051.
7.	Bharat Heavy Electricals Limited, BHEL, Industry Sector, Integrated office complex Lodhi Road, New Delhi-110003.
8.	Kyosan India Private Limited, No-601, 6th Floor, Eros Corporate Tower, Nehru Place, NewDelhi – 110019.
9.	Siemens Limited, Belapur Road, Opp. Airoli Station, Navi Mumbai, Maharashtra – 400708.
10.	Bharat Electronics Limited, Kotdwara Pauri Garhwal,Uttarakhand – 246149.
11.	Kaynes Technology India Limited, 23-25, Belagola Food Indl. Estate Metagalli, Mysore, Karnataka – 570016.
12.	M/s Lotus Wireless Technologies India Private Limited, B-7, EEIE, B-Block, Industrial Park Auto Nagar Visakhapatnam, Andhra Pradesh – 530012.
13.	M/s Progota India Private Limited, C-1A/104-B, Janak Puri West, New Delhi-110058.

Sub: Standard Operating Procedure (SOP) for Generic Product Approval of KAVACH.

Vide subject above, competent authority has approved the Standard Operating Procedure (SOP) for Generic Product Approval of KAVACH.

A copy of Standard Operating Procedure (SOP) for Generic Product Approval of KAVACH is enclosed herewith for your information please.

DA: As above

Digitally Signed by Madhup
Mohan Srivastava
(Madhup Mohan Srivastava)
Date: 09-05-2025 12:02:17
Director / Signal-IV
Reason: Approved

Copy to: : For information please

1. PED/S&T/Dev, Railway Board, New Delhi
2. PED/COE, Tarnaka Road, Mettuguda, Secunderabad - 500017.

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सत्यमेव जयते

GOVERNMENT OF INDIA

(भारत सरकार)

MINISTRY OF RAILWAYS

(रेल मंत्रालय)

**Standard Operating Procedure (SOP)
for
Generic Product Approval of KAVACH**

Document No. 1506

Version 1.0

Issued by

SIGNAL & TELECOM DIRECTORATE
RESEARCH, DESIGNS & STANDARDS ORGANISATION
MINISTRY OF RAILWAYS
LUCKNOW – 226 011



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Summary

SN	Description	SRS Clause
1.	Capacity Cum Capability Assessment	Cl.4.8 of QO-D-8.1-6
	Prerequisite: <ul style="list-style-type: none"> Initial Scrutiny of OEM Application accepted by RDSO. 	
	Conditions for Approval: <ul style="list-style-type: none"> Verification of all the documents submitted during the application successfully completed. All necessary M&P items available with the firm ensured during factory audit. 	
	Successful Completion of this will enable start of Lab testing, Field trials and ISA	
2	Lab Testing	
2.1	Acceptance Test	
	Prerequisite: <ul style="list-style-type: none"> CCA accepted. Firm ready with Prototype Sample (02 SKAVACH,02 Onboard KAVACH, 6 RIU) Routine Test report submitted. 	
	Conditions for Approval: <ul style="list-style-type: none"> The firm should comply with all basic functions and be ready for customer use. Necessary compliance of minimal functionality specified in Acceptance Test Format. 	
2.2	Type Test	SRS Cl.25.4
	Prerequisite: <ul style="list-style-type: none"> Successful completion of Acceptance Test. 	
	Conditions for Approval: <ul style="list-style-type: none"> The Firm should comply with minimum design related parameters specified in the Type Test Format. All environmental Tests shall be complied. 	
2.3	Functional Test	SRS Cl.25.5
	Prerequisite: <ul style="list-style-type: none"> Successful completion of Type Test. 	
	Conditions for Approval: <ul style="list-style-type: none"> All the Functions defined in the Functional Test Format to be tested and verified categories of tests linked. Executive checksum of the Product will be frozen. SVK, OVK, DMI, Event logger. 	

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SN	Description	SRS Clause
2.4	Interoperability Lab Test	SRS Cl.25.6
	Prerequisite: <ul style="list-style-type: none"> 70% Functional Testing completed. Test installation completed in IRISSET. 	
	Conditions for Approval: <ul style="list-style-type: none"> Lab tests governed by the test format SIF 0594, including KMS Keys, MA, Track Profile and other safety-related tests completed. 	
3.	Field Trials	
3.1	Trial Order	
	Prerequisite: <ul style="list-style-type: none"> CCA Accepted. Section identified in consultation with Zonal Railway NIT is published. 	
	Conditions for Placing Order: <ul style="list-style-type: none"> Tender finalized by Zonal Railway in favour of OEM. 	
3.2	Equipment Installation, FAT and SAT	
	Prerequisite: <ul style="list-style-type: none"> Type test completed. Trial order finalized. RFID Tag Tin Layouts and TOC approved. 	
	Conditions for Completion: <ul style="list-style-type: none"> PCCL of OnboardKavach completed. FAT and SAT of Stationary KAVACH completed. PCCL of Stationary Kavach completed. 	
3.3	Light Engine Field Trial (no BIU)	SRS Cl.25.7 (e)
	Prerequisite: <ul style="list-style-type: none"> Equipment Installation and PCCL Completed. Minimum 70% Functional Test completed. Tentative Checksum given by the firm. FAT and SAT completed. 	
	Conditions for Completion of Light Engine Trial: <ul style="list-style-type: none"> Approx 10 Light Engine/EMU trials in other vendor sections successful (no emergency braking and 98.5% operating availability) to the satisfaction of OEM. Approx 10 Light Engine/EMU trials in the trial section of vendor under approval (no emergency braking and 98.5% operating availability) to the satisfaction of OEM. 	

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SN	Description	SRS Clause
3.4	Braking Parameters Finalization	SRS Cl.25.7 (c)
	Prerequisite: <ul style="list-style-type: none"> • “No BIU” trial runs were successful to the satisfaction of OEM. 	
	Conditions for Completion of Braking Parameters finalization: <ul style="list-style-type: none"> • Uniformity certification completed. • Braking Parameters finalized for LHB and ICF formations for Passenger Trains under Trial. • Braking Parameters for EMU, VB trains and goods formation to continue. 	
3.5	Light Engine Field Trial (With BIU)	SRS Cl.25.7 (e)
	Prerequisite: <ul style="list-style-type: none"> • Type Test Approval • 85% Functional Test completed. • Braking Parameters are finalized. • Field Trial Section ready with equipment installed. • FAT and SAT completed. • All Trial section details (Tag Layout, TOC etc) submitted. • Checksum given by the firm. 	
	Conditions for Completion of Light Engine Trial: <ul style="list-style-type: none"> • 10 Light Engine/EMU trials in own sections were successful with all scenarios mentioned in SRS. 	
3.6	Interoperability Field Trial	Cl. N.A
	Prerequisite: <ul style="list-style-type: none"> • Interoperability Lab Tests completed. • 85% Functional Test completed. • Braking Parameters are finalized. 	
	Conditions for completion of in trial: <ul style="list-style-type: none"> • Field trials for all scenarios at least in two other approved vendors (at the highest speed possible). • For Stationary Kavach trial - Movement (LE and with Formation) of other two vendors for Onboard Kavach (for which Generic Approval given) required in the section of stationary KAVACH under Trial. • For Onboard KAVACH Trial- Movement (LE and with Formation) of the Onboard KAVACH under trial required in the section of two vendors of stationary Kavach (for which Generic Approval given). 	
3.7	160 Km/h trials	SRS Cl.26.2

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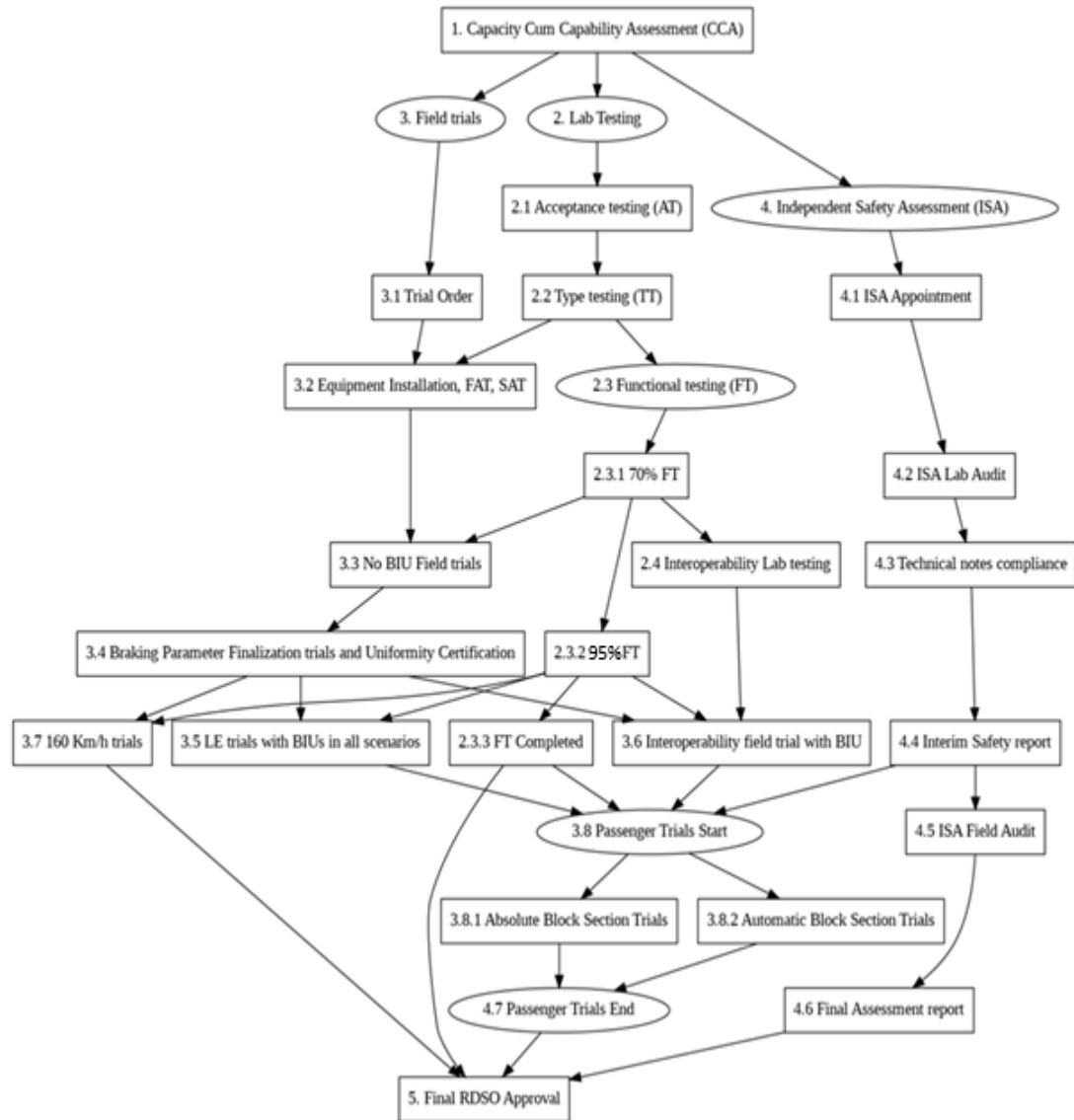
SN	Description	SRS Clause
	Prerequisite: <ul style="list-style-type: none"> • Light Engine Field Trial with all scenarios completed. • Braking parameters finalized for WAP-5 Loco with Formation. • 85% Functional Test completed. • Braking Parameters are finalized. 	
	Conditions for Completion of 160 Km/h Field Trial: <ul style="list-style-type: none"> • For 160 km/h, two trials in the nominated section for a cumulative distance of 50 km for at least two days for all scenarios with WAP-5 Loco for all scenarios mentioned for LE trial. • No RF fluctuations. • RFID tag reads (min 2 reads from each reader). • No spurious Emergency Braking in these trials. • Operational Availability 98.5%. 	
3.8	Passenger Field Trials	
3.8.1	Passenger Field Trial (Absolute Block)	SRS Cl.26.1
	Prerequisite: <ul style="list-style-type: none"> • Light Engine Field Trial with all scenarios completed. • Braking parameters finalized for Loco and formation under trial. • Receipt of Interim ISA report. • Completion of Functional Testing. 	
	Conditions for Completion of Passenger Field Trial: <ul style="list-style-type: none"> • 30 days** passenger carrying trains in Absolute Block Trial Section in controlled* environment. • No spurious Emergency Braking in these trials. • Operational Availability: 98.5%. 	
	<i>*Accompanied by OEM and Railway Staff.</i> <i>** Each day will be considered as a “to” and “fro” movement in min 3 SVK territories for one OVK.</i> If a firm has more number of section, it cannot be splitted	
3.8.2	Passenger Field Trial (Auto Block)	SRS Cl.26.3
	Prerequisite: <ul style="list-style-type: none"> • Light Engine Field Trial with all scenarios completed. • Braking parameters finalized for Loco and formation under trial. • Receipt of Interim ISA report. • Completion of functional testing. 	
	Conditions for Completion of Passenger Field Trial:	

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SN	Description	SRS Clause
	<ul style="list-style-type: none"> A cumulative distance of 5000 kms of run on passenger carrying trains and 2500 hrs of continuous KAVACH & RIU operation. Minimum one auto block section for new vendor. No spurious Emergency Braking in these trials. Operational Availability 98.5%. 	
4.	Independent Safety Assessment	
4.1	ISA appointed	
4.2	ISA factory audit and lab testing completed	
4.3	Technical notes compliance	
4.4	Interim ISA report	Cl.N.A.
	Pre-requisite: <ul style="list-style-type: none"> ISA appointed ISA factory audit and lab testing completed 	
	Condition for approval: <ul style="list-style-type: none"> Technical notes compliance 	
	Report from ISA stating that no blocking points for the continuation of validation activities of Kavach field trials.	
4.5	ISA Field Audit	
	Prerequisite: <ul style="list-style-type: none"> Technical Notes are complied. Hazard analysis complete. 	
	Conditions for Submission of ISA Assessment Report: <ul style="list-style-type: none"> Field testing successful for degraded track conditions. 	
4.6	ISA Assessment	SRS Cl.23.2
	Prerequisite: <ul style="list-style-type: none"> All necessary Quality and Safety Documents submitted to ISA by the Firm. 	
	Conditions for Submission of ISA Assessment Report: <ul style="list-style-type: none"> All Functional and Safety Documents submitted to ISA. Field Audit completed by ISA. Hazard mitigation report submitted by the firm. 	
5.	Generic Approval	
	Prerequisite: <ul style="list-style-type: none"> Functional Test completed. Passenger Field Trial completed successfully. Interoperability Field Trial completed successfully. ISA Assessment report submitted. Compliance of SRAC (Safety related Application Conditions) by the Firm. 	
	Conditions for Approval: <ul style="list-style-type: none"> Checking and compliance of all the documents submitted. 	

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Stages for Generic Approval



Note: Any change in approval process will be implemented as per latest guideline.

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1.Capacity Cum Capability Assessment (CCA)

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1.1. Registration by firm

The firm has to register online through UVAM Module at link [Login-Indian Railways tenders for Goods, Works and Services](#) and upload the requisite documents mentioned in ISO documents QO-D-8.1-5 or latest.

1.2. Document Scrutiny

After registration, the document scrutiny is carried out by RDSO for considering the case for the CCA. The case is forwarded for verification of CCA to field unit of RDSO.

1.3. Factory Audit

Nominated RDSO official(s) will visit the firm's premises for schedule of technical requirement (STR¹) verification and assess the capability of the firm and arrive at their annual production capacity. Also digitally signed uploaded documents during registration are checked and verified with the originals. Legal documents are also verified with actual copies and nominated official will bring all legal affidavits in original with him to RDSO.

1.4. After meeting the above requirements and with due approval of competent authority, firm will be advised to submit the proto type sample for the acceptance testing.

Summary_

1.	Capacity Cum Capability Assessment	Cl.4.8 of QO-D-8.1-6
	Prerequisite: <ul style="list-style-type: none"> Documents submitted by OEM during registration are scrutinised Application accepted and forwarded to field unit 	
	Conditions for Approval: <ul style="list-style-type: none"> Verification of all the documents submitted during the application successfully completed. All necessary M&P items available with the firm ensured during factory audit. 	
	Successful Completion of this will enable start of Lab testing, Field trials and ISA.	

¹STR includes machinery and plant, tool and lab equipment required to produce KAVACH.

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2.LAB TESTING

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- (a) Lab testing consists of two parts i.e. Acceptance and type test.
- (b) The firm is asked to manufacture **Prototype Sample (02 Stationary KAVACH, 02 Onboard KAVACH and 6 RIU)** confirming to the specification after Successful completion of capability cum capacity assessment.
- (c) Firm has to submit the draft acceptance and type test format based on the standard template which has standard general functional parameter as per specification requirement for the hardware. The standard formats are uploaded on the RDSO website https://rdso.indianrailways.gov.in/view_section.jsp?lang=0&id=0,2,6669,6670,6672.
- (d) On manufacture of the prototype sample, the firm shall conduct routine tests and environmental stress screen test on cards with proper records. Firm shall request to the regional head of S&T field unit and S&T Directorate/RDSO/Lucknow for conducting acceptance test along with submission of routine test results.

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2.1. Acceptance Testing of prototype Sample

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- 2.1.1. The acceptance test can be carried out by RDSO representative at firm's premises or at any other approved test house/ laboratory on approved acceptance test format as per ISO guideline (QO-D).
- 2.1.2. The following tests shall comprise acceptance tests:
- Visual inspection.
 - Insulation Resistance tests.
 - Applied high voltage tests.
 - Card level/ module level check.
 - Card-level functional tests on all the cards.
 - System level functional tests/ performance tests.
 - System diagnostic tests.
- 2.1.3. After successfully passing the Acceptance tests, the report will be sent to S&T Directorate along with details on format no. QS-F-8.1-7 (latest version) and forwarding letter for type tests including Acceptance Test reports and Routine Test reports.
- 2.1.4. If sample fails during acceptance test, if the vendor desires for re-testing of same sample/prototype or retesting of improvised sample/prototype, he may do so by submitting the details of technical explanation or corrective action taken to improve the product, as per the case, especially for the parameters which were found non-conforming during earlier testing.
- 2.1.5. One more opportunity to firm can be granted by competent authority to submit the improvised sample/prototype within the specified time.
- 2.1.6. After giving all the opportunities as stated above, if sample/prototype doesn't get cleared, the case shall be rejected.
- 2.1.7. **Summary**

2.1	Acceptance Test
	Prerequisite: <ul style="list-style-type: none"> CCA accepted. Firm ready with Prototype Sample (02 SKAVACH,02 Onboard KAVACH, 6 RIU) Routine Test report submitted.
	Conditions for Approval: <ul style="list-style-type: none"> The firm should comply with all basic functions and be ready for customer use. Necessary compliance of minimal functionality specified in Acceptance Test Format.

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2.2. **Type Testing of Prototype Sample**

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- 2.2.1. After successful verification of acceptance test report, the firm shall request for permission of lab for type testing.
- 2.2.2. Those Type Tests which are to be done at firm's premises shall invariably be conducted under direct supervision of representative(s) of S&T Directorate.
- 2.2.3. Type testing is carried out in one set of sample and 2nd sample set is kept in sealed condition.
- 2.2.4. The following tests shall constitute type tests:
- Visual inspection.
 - Insulation Resistance tests.
 - Applied high voltage tests.
 - Card level/ module level check.
 - Card-level functional tests one card of each type.
 - System level functional tests/ performance tests.
 - Environmental / Climatic tests. Vibration tests, abrasive environment tests.
 - System diagnostic tests.
 - Integration tests: Integration tests to integrate the various sub systems of the KAVACH and demonstrate correct operation of all internal and external interfaces.
- 2.2.5. After successfully passing the type tests, the report shall be put up to competent authority and technical clearance shall be given for hardware approval to supply for field trial and commence functional testing.
- 2.2.6. If sample fails during type test, if the vendor desires for re-testing of same sample/prototype or retesting of improvised sample/prototype, he may do so by submitting the details of technical explanation or corrective action taken to improve the product, as per the case, especially for the parameters which were found non-conforming during earlier testing.
- 2.2.7. One more opportunity to firm can be granted by competent authority to submit the improvised sample/prototype within the specified time.
- 2.2.8. After giving all the opportunities as stated above, if sample/prototype doesn't get cleared, the case shall be rejected.
- 2.2.9. **Summary:**

2.2	Type Test	SRS Cl.25.4
	Prerequisite: • Successful completion of Acceptance Test.	
	Conditions for Approval: • The Firm should comply with minimum design related parameters specified in the Type Test Format.	

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	• All environmental Tests shall be complied.	
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2.3. Functional Test

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- 2.3.1. The functional tests shall be carried out after successful type test and internal V&V testing. The functional tests shall be carried out to demonstrate that the complete KAVACH system operates correctly in accordance with the Specifications. The functional tests shall sequence through all required operations to prove that the system performs in accordance with the Specification and that the local configuration of data is correct. Where necessary, input conditions shall be simulated.
- 2.3.2. Based on the system requirement specification, the functional test format of DMI (**SIF-0522**), Functional test format of KAVACH system (**SIF-0533**), Functional test format of Event logger (**SIF-595**) have been prepared and uploaded in website https://rdso.indianrailways.gov.in/view_section.jsp?lang=0&id=0,2,6669,6670,6672
- 2.3.3. All the Functions defined in the Functional Test Format to be tested and verified by the RDSO official at the firm premises/ lab.
- 2.3.4. **Summary:**

2.3	Functional Test	SRS Cl.25.5
	Prerequisite: <ul style="list-style-type: none"> Successful completion of Type Test. 	
	Conditions for Approval: <ul style="list-style-type: none"> All the Functions defined in the Functional Test Format to be tested and verified categories of tests linked. Executive checksum of the Product will be frozen. SVK, OVK, DMI, Event logger. 	

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2.4. Interoperability Lab Test

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2.4.1. Prerequisite: -

- (a) Minimum 70 % functional testing is to completed by the firm and CRC based on 70% testing shall be frozen.
- (b) System shall be installed either IRISSET/RDSO lab for carrying out interoperability test.

2.4.2. The KAVACH system developed by a vendor shall be interoperable with at least two existing vendors. This shall be tested in RDSO lab or IRISSET Lab for communication between Onboard KAVACH of applying vendor with Stationary KAVACH of existing vendors and Stationary KAVACH of applying vendor with Onboard KAVACH of existing vendors.

Note: While approving first two vendors, as no vendor has been approved for KAVACH, Interoperability testing of first two vendors shall be completed by testing with each other as a special condition.

2.4.3. Based on the system requirement specification, the KAVACH Interoperability test format SIF-0594 for various scenarios have been prepared and uploaded in website https://rdso.indianrailways.gov.in/view_section.jsp?lang=0&id=0,2,6669,6670,6672.

2.4.4. All the Interoperability test defined in the Interoperability test Format to be tested and verified by the RDSO official at the RDSO or IRISSET lab.

2.4.5. Summary:

2.4	Interoperability Lab Test	SRS Cl.25.6
	Prerequisite: <ul style="list-style-type: none"> • 70% Functional Testing completed. • Test installation completed in IRISSET/RDSO. 	
	Conditions for Approval: <ul style="list-style-type: none"> • Lab tests governed by the test format SIF 0594, including KMS Keys, MA, Track Profile and other safety-related tests completed. 	

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3.Field Trials

(As per clause 25.7 of System Requirement specification of
RDSO/SPN/196/2020 Version 4.0)

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3.1. **Field Trial Order:**

3.1.1. **Prerequisite:**

- (a) Capacity capability assessment completed.
- (b) Section identified in consultation with Zonal Railway and allotted for field trial to new vendors.
- (c) Notice Inviting Tender is published.
- (d) Tender finalized by Zonal Railway in favour of OEM.

3.1.2. The trial order will be allotted to new vendor for field trial with minimum 5 Stationary KAVACH, 05 Remote interface unit and 10 Onboard KAVACH.

3.1.3. Stationary KAVACH territory shall consist of absolute and auto section.

3.1.4. Onboard KAVACH shall be allotted in such a way that different types of loco/EMU/VB trains are catered.

3.1.5. **Summary**

3.1	Field Trial Order	
	Prerequisite: <ul style="list-style-type: none"> • CCA Accepted. • Section identified in consultation with Zonal Railway • NIT is published. 	
	Conditions for Placing Order: <ul style="list-style-type: none"> • Tender finalized by Zonal Railway in favour of OEM. 	

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3.2. Equipment Installation, FAT and SAT

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3.2.1. **Prerequisite**

- a) Type test completed and approval from RDSO for supply of material.
- b) Field Trial order finalized.
- c) RFID Tag TIN Layouts and TOC approved.

3.2.2. The following shall be submitted to RDSO for minimum one station and shall be got approved before the start of the trial:

- (a) The RFID layouts, Tag data, KAVACH control table and wiring diagrams.
- (b) All executive and application data.

3.2.3. **Factory Acceptance test:** Firm shall offer for FAT testing of one station after internal V&V FAT testing as per Factory Acceptance Test Scheme for Stationary KAVACH Application Logic for Version 4.0 format (**SIF-0515**) to RDSO for witnessing. The FAT certificate will be generated as per latest Executive software CRC and application data file CRC. The FAT format uploaded in website.
https://rdso.indianrailways.gov.in/view_section.jsp?lang=0&id=0,2,6669,6670,6672

3.2.4. **Site acceptance test:** Firm carry out the site acceptance test as per Site Acceptance Test Scheme for Stationary KAVACH (IRATP) Application Logic for Version 4.0 format (**SIF-0593**) along with the executing Railway. The SAT format uploaded in website
https://rdso.indianrailways.gov.in/view_section.jsp?lang=0&id=0,2,6669,6670,6672

3.2.5. **PCCL of Stationary KAVACH:** Firm and executing Railway will carry out the pre-commissioning check as per as Pre-commissioning check list for Stationary KAVACH as per RDSO/SPN/196/2020 Ver 4.0(**SIF-0577**) issued by RDSO. The PCCL format is uploaded in website
http://10.100.2.19/01_english/signal/KAVACH/compendium.htm

3.2.6. **PCCL of onboard KAVACH:** Firm and executing Railway will carry out the pre-commissioning check as per Pre-Commissioning Checklist for Onboard KAVACH (Diesel/Electrical) as per specification RDSO/SPN/196/2020 version 4.0 (SIF-0576) issued by RDSO. The PCCL format for onboard KAVACH is uploaded
http://10.100.2.19/01_english/signal/KAVACH/compendium.htm

3.2.7. **Summary:**

3.2	Equipment Installation, FAT and SAT	
	Prerequisite: <ul style="list-style-type: none"> • Type test completed. • Trial order finalized. • RFID Tag TIN Layouts and TOC approved. 	
	Conditions for Completion:	

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	<ul style="list-style-type: none"> • PCCL of Onboard KAVACH completed. • FAT and SAT of Stationary KAVACH completed. • PCCL of Stationary KAVACH completed. 	
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3.3. Field Trial (No BIU)

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3.3.1. **Prerequisite:**

- (a) Equipment Installation and PCCL Completed.
- (b) Minimum 70% Functional Test completed.
- (c) Tentative Checksum submitted by the firm in format SIF-0521.
- (d) FAT and SAT completed.

3.3.2. **Condition for completing no BIU field trial in existing vendor section**

- (a) Light Engine/EMU/Passenger Train with no brake interface trial under supervision of RDSO and OEM to check for basic functionality of Onboard KAVACH:
 - a. Boot up sequence
 - b. Registration
 - c. RFID Tag Reading
 - d. Regular packet exchange
 - e. Speed sensing
 - f. Odometer error correction
 - g. Auto whistling of horn
 - h. Train Length Assignment
 - i. Speed margin
 - j. Permitted speed monitoring
 - k. Roll back protection
 - l. Mode transition
 - m. SOS feature
- (b) All the issue observed in trials are to be mitigated.
- (c) Report shall be submitted to this office after satisfaction of OEM.

3.3.3. **Summary**

3.3	Field Trial (no BIU)	Cl.25.7(e)
	Prerequisite: <ul style="list-style-type: none"> • Equipment Installation and PCCL Completed. • Minimum 70% Functional Test completed. • Tentative Checksum given by the firm. • FAT and SAT completed. 	
	Conditions for Completion of Trial with no BIU: <ul style="list-style-type: none"> • Approx 10 Light Engine/EMU/passenger train trials in existing vendor sections successful (no emergency braking and 98.5% operating availability in each trial) to the satisfaction of OEM. 	

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3.4. Braking Parameters Finalization

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3.4.1. **Prerequisite:**

- (a) “No BIU” trial runs were successful to the satisfaction of OEM.
- (b) Proper behaviour of simulated data in the tool provided by COE.

3.4.2. **Conditions for Completion of Braking Parameters finalization through COE:**

- (a) Uniformity certification completed for the allotted loco variant as a light engine.
- (b) Braking Parameters finalized for LHB and ICF formations for Passenger Trains under Trial for the allotted loco variant.
- (c) Braking Parameters for EMU, VB trains and goods formation to continue and approval will be given based on the trial.

3.4.3. **Summary:**

3.4	Braking Parameters Finalization through COE	SRS Cl.25.7 (c)
	Prerequisite: <ul style="list-style-type: none"> • “No BIU” trial runs were successful to the satisfaction of OEM. • Proper behaviour of simulated data in the tool provided by COE. 	
	Conditions for Completion of Braking Parameters finalization: <ul style="list-style-type: none"> • Uniformity certification completed. • Braking Parameters finalized for LE, LHB and ICF formations for Passenger Trains under Trial. • Braking Parameters for EMU, VB trains and goods formation to continue. 	

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3.5. Light Engine Field Trial (With BIU)

3.5.1. **Prerequisite:**

- (a) Type Test Approval.
- (b) 85% Functional Test completed.
- (c) Braking Parameters are finalized.
- (d) Field Trial Section ready with equipment installed.
- (e) All Trial section details (Tag Layout, TOC etc.) submitted and approved.
- (f) FAT and SAT completed.
- (g) Executive Check sum submitted to RDSO in proper format **SIF-0521** after V&V team validation for approval.
- (h) No BIU trials satisfactory in section of vendor under approval.

3.5.2. **Light engine with BIU trial in own section**

- (a) 10 trip² Light engine trial will be conducted with all feature i.e. loop line speed control, SPAD Prevention, head on collision, rear end collision, PSR, automatic whistling of horn, train length assignment, speed margin, protection of rollback, RFID Tag linking, KMS key, handing over and taking over of border tag, all SOS features finalised parameters shall be submitted and report shall be prepared in KAVACH Field Trial for Various Scenarios - Observation Format / Site Acceptance Testing Format (**SIF-0524**) with joint witnessing RDSO/Zonal railway official.
- (b) 10 Light Engine/EMU trials in own sections were successful with all scenarios mentioned in above para (a) above without any spurious braking.
- (c) The operational availability (without spurious braking, Track Identification failures, etc.) shall be calculated by the RAMS Manager of the firm and submitted to RDSO along with NMS log.

3.5.3. **Summary**

3.5	Light Engine Field Trial (With BIU)	Cl.25.7 (e)
	Prerequisite: <ul style="list-style-type: none"> • Type Test Approval • 85% Functional Test completed. • Braking Parameters are finalized. • Field Trial Section ready with equipment installed. • FAT and SAT completed. 	

²Each trip will be considered as a to and through movement of one Onboard KAVACH in the trial section.

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	<ul style="list-style-type: none"> • All Trial section details (Tag Layout, TOC etc) submitted. • Checksum given by the firm. • No BIU trials satisfactory in section of vendor under approval. 	
	<p>Conditions for Completion of Light Engine Trial:</p> <ul style="list-style-type: none"> • 10 Light Engine/EMU trials in own sections were successful with all scenarios mentioned in SRS. 	

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3.6. Interoperability Field Trial

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3.6.1. **Prerequisite:**

- (a) Interoperability Lab Tests completed in the RDSO/IRISET lab and report is found satisfactory.
- (b) 95 % Functional Test completed.
- (c) Braking Parameters are finalized and 10 trip light engine trial completed without any issue.

3.6.2. **Conditions for completion of Interoperability trial:**

Field trials for all scenarios at least in two other existing vendors (at the highest speed possible).

Note: As initially no vendor has been approved for Kavach, Interoperability testing of first two vendors shall be completed by testing with each other as a special condition.

3.6.3. **Field trial Conditions for completion of stationary KAVACH (For KAVACH Generic Application Approval)**

Light engine with formation field trials with Onboard KAVACH of other two approved vendors shall be carried out in the section equipped with Stationary KAVACH of vendor under approval for all scenarios i.e. loop line speed control, SPAD Prevention, head on collision, rear end collision, PSR, automatic whistling of horn, train length assignment, speed margin, RFID Tag linking, KMS key, handing over and taking over of border tag, protection of rollback, SOS, override and degraded conditions like radio communication fail, Tag missing, EI communication fail and SKAVACH communication fail (at the highest speed possible).

3.6.4. **Field trial Conditions for completion of onboard KAVACH (For KAVACH Generic Application Approval)**

Light engine with formation field trials in stationary KAVACH sections equipped with at least two approved vendors shall be carried out for all scenarios i.e. loop line speed control, SPAD Prevention, head on collision, rear end collision, PSR, automatic whistling of horn, train length assignment, speed margin, protection of rollback, RFID Tag linking, KMS key, handing over and taking over of border tag, SOS override and degraded conditions like radio communication fail, Tag missing, EI communication fail and SKAVACH communication fail (at the highest speed possible).

3.6.5. Report shall be prepared and submitted to RDSO in format KAVACH Interoperability test format for various scenarios with approved vendors (**SIF-0594**) with joint witnessing RDSO/Zonal railway official.

3.6.6. **Summary:**

3.6	Interoperability Field Trial
	Prerequisite:

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	<ul style="list-style-type: none"> • Interoperability Lab Tests completed. • 95% Functional Test completed. • Braking Parameters are finalized.
	<p>Conditions for completion of Interoperability trial:</p> <ul style="list-style-type: none"> • Field trials for all scenarios at least in two other existing vendors (at the highest speed possible). • For Stationary KAVACH trial - Movement (LE and with Formation) of existing two vendors for Onboard KAVACH (for which Generic Approval given) required in the section of Stationary KAVACH under Trial. • For Onboard KAVACH Trial- Movement (LE and with Formation) of the Onboard KAVACH under trial required in the section of two existing vendors of Stationary KAVACH under approval (for which Generic Approval given).

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3.7. Semi high Speed (160 Km/h) trials

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3.7.1. **Prerequisite:**

- (a) Light Engine Field Trial with all scenarios completed.
- (b) Braking parameters finalized for WAP-5 Loco with Formation.
- (c) 95% Functional Test completed.
- (d) Braking Parameters are finalized.

1.1.1. **Conditions for Completion of 160 Km/h Field Trial:**

- (a) For 160 km/h, two trials in the nominated section for a cumulative distance of 50 km for at least two days for all scenarios with WAP-5 Loco with any one formation or VB train set i.e. loop line speed control, SPAD Prevention, head on collision, rear end collision, PSR, automatic whistling of horn, train length assignment, speed margin, protection of rollback, SOS, RFID Tag linking, KMS key, handing over and taking over of border tag.
- (b) No RF fluctuations.
- (c) RFID tag reads (min 2 reads from each reader) shall be logged.
- (d) No spurious Emergency Braking in these trials.
- (e) Operational Availability 98.5% per trial.

1.1.2. **Summary:**

3.7	160 Km/h trials	Cl.26.2
	Prerequisite: <ul style="list-style-type: none"> • Light Engine Field Trial with all scenarios completed. • Braking parameters finalized for WAP-5 Loco with Formation. • 95% Functional Test completed. • Braking Parameters are finalized. 	
	Conditions for Completion of 160 Km/h Field Trial: <ul style="list-style-type: none"> • For 160 km/h, two trials in the nominated section for a cumulative distance of 50 km for at least two days for all scenarios with WAP-5 Loco mentioned for LE trial. • No RF fluctuations. • RFID tag reads (min 2 reads from each reader). • No spurious Emergency Braking in these trials. • Operational Availability 98.5%. 	

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3.8. Passenger Field Trials

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3.8.1. **Prerequisite:**

- (a) Light Engine Field Trial with all scenarios completed and found satisfactory without any spurious braking.
- (b) Braking parameters finalized for Loco and formation under trial.
- (c) Receipt of Interim ISA report.
- (d) Completion of functional testing.

3.8.2. **Conditions for Completion of Passenger Field Trial (Absolute Block):**

- (a) 30 days³ passenger carrying trains in Absolute Block Trial Section in controlled⁴ environment.
- (b) The operational availability (without spurious braking, Track Identification failures, etc.) shall be submitted to RDSO in format KAVACH Field Trial for Various Scenarios - Observation Format / Site Acceptance Testing Format (**SIF-0524**) with witnessing of RDSO or Railway official.
- (c) During the passenger trial, change in executive software or application of spurious braking for any reason will result in repeat of field trial afresh. Previous passenger trial will not be counted. The passenger trial is to be started as afresh. The firm has to submit the reason for change and ask for approval from RDSO in format **SIF-0521** after V&V team validation.
- (d) If spurious braking due to signal failure or railway signal failure, then the trip will be excluded with submission of proper evidence of log etc.
- (e) The operational availability⁵ in terms of successful trips (without spurious braking, Track Identification failures, etc.) shall not be less than 98.5% on a weekly basis.

3.8.3. **Summary**

3.8.1	Passenger Field Trial (Absolute Block)	SRS Cl.26.1
	Prerequisite: <ul style="list-style-type: none"> • Light Engine Field Trial with all scenarios completed. • Braking parameters finalized for Loco and formation under trial. • Receipt of Interim ISA report. • Completion of Functional Testing. 	

³Each day will be considered as a "to" and "fro" movement in min 3 SVK territories for one OVK. If a firm has more number of section, it cannot be splitted.

⁴Controlled means that accompanied by OEM and Railway Staff in passenger train and loco pilot will control the train in case of any spurious issue.

⁵Mean up time is the sum of Stand By, Onsite and Full Supervision Mode.

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	<p>Conditions for Completion of Passenger Field Trial:</p> <ul style="list-style-type: none"> • 30 days** passenger carrying trains in Absolute Block Trial Section in controlled* environment. • No spurious Emergency Braking in these trials. • Operational Availability: 98.5%. 	
	<p><i>*Accompanied by OEM and Railway Staff.</i></p> <p><i>** Each day will be considered as a “to” and “fro” movement in min 3 SVK territories for one OVK.</i> If a firm has more number of section, it cannot be splitted</p>	

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3.9. Passenger Field Trial (Auto Block)

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3.9.1. **Prerequisite:**

- (a) Light Engine Field Trial with all scenarios completed and found satisfactory without any spurious braking.
- (b) Braking parameters finalized for Loco and formation under trial.
- (c) Receipt of Interim ISA report.
- (d) Completion of functional testing

3.9.2. **Conditions for Completion of Passenger Field Trial (Auto Block):**

- (a) A cumulative distance of 5000 kms of run on passenger carrying trains and Auto Block Trial Section in controlled⁶ environment.
- (b) 2500 hrs of continuous working of stationary KAVACH & Remote Interface unit (RIU) operation without any issue of failure. Report shall be submitted jointly with executing Railway along with NMS log.
- (c) The operational availability (without spurious braking, Track Identification failures, etc.) shall be submitted to RDSO in format KAVACH Field Trial for Various Scenarios - Observation Format / Site Acceptance Testing Format (**SIF-0524**) with witnessing of RDSO or Railway official.
- (d) Minimum one auto block section for a new vendor is mandatory.
- (e) If Executive CRC is modified during the passenger trial, then firm has to submit the reason for change in CRC and ask for approval from RDSO for the same in format **SIF-0521** after V&V team validation.
- (f) Previous passenger trial will not be counted. The passenger trial is start as a fresh.
- (g) If spurious braking due to signal failure or railway signal failure, then the trip will be excluded with submission of proper evidence of log etc.
- (h) The operational availability⁷ in terms of successful trips (without spurious braking, Track Identification failures, etc.) shall not be less than 98.5% on a weekly basis.

$$Availability = \frac{Mean\ Up\ time}{Mean\ Up\ time + Mean\ Down\ time}$$

⁶Controlled means that accompanied by OEM and Railway Staff in passenger train and loco pilot will control the train in case of any spurious issue.

⁷Mean up time is the sum of Stand By, Onsite and Full Supervision Mode.

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4. Independent Safety Assessment

(As per clause 23.2.3, 23.2.4 & 23.2.7 of System Requirement specification of RDSO/SPN/196/2020 Version 4.0)

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4.1. Independent Safety Assessment (ISA) appointed:

- 4.1.1. KAVACH OEM shall select the Independent Safety Assessors from the RDSO approved panel of ISA for a generic Signalling Product/System. The ISA panel for signalling projects and products has been issued by S&T directorate of RDSO & posted on RDSO website.
- 4.1.2. KAVACH OEM shall request to RDSO for appointment of ISA. RDSO shall permit ISA Assessor with the approval of competent authority.

4.2. ISA factory audit and lab testing completed:

- 4.2.1. ISA shall visit the firm's factory and verify the lab testing facilities.

4.3. Technical notes compliance:

- 4.3.1. ISA shall verify and validate software and hardware of the system as per Safety Integrity Level 4 (SIL-4) of CENELEC standards or equivalent.
- 4.3.2. ISA will perform the card level & system level fail safety test.
- 4.3.3. Firm shall submit the certificate and compliance of the report to RDSO.

4.4. Interim ISA Report:

- 4.4.1. ISA shall submit the interim ISA report of hardware and software of the system.
- 4.4.2. The ISA assessment shall be carried out and all the concerned Verification & Validation documents are required to be submitted to RDSO.
- 4.4.3. Report from ISA shall be clearly mentioned that "*no blocking points for the continuation of validation activities of KAVACH field trial*".
- 4.4.4. This should be submitted for start of controlled passenger field trials.

4.5. ISA Field Audit:

- 4.5.1. ISA shall carry out field audit of concerned firm's section for degraded track conditions.
- 4.5.2. Successful Field Audit report of field trial is to be submitted.

4.6. ISA Assessment:

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4.6.1. Firm shall submit the ISA Assessment report to RDSO with following condition:

- a) All Functional and Safety Documents submitted by the firm to ISA.
- b) The ISA assessment shall be carried out and all the concerned Verification & Validation documents are required to be submitted to RDSO. The documents shall include Hazard log, PHA (Preliminary Hazard Analysis), SSHA (Sub System Hazard Analysis), FHA (Functional Hazard Analysis), THR (Tolerable Hazard Rate) evaluations, Reliability evaluations, Software evaluation (white box testing), Protocol evaluation and Generic Application Safety Case.
- c) Hazard mitigation report shall also to be submitted by the firm to RDSO.

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5. RDSO Approval

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5.1 The following are scrutinized before placing the firm as approved for developmental orders

S. No.	Documents Description	Submitted / Not Submitted	Target Date	RDSO Comments
1.	Type test report for hardware of KAVACH			
1.1.	Verified & Approved QAP			
1.2.	Annual Production Capacity of KAVACH system			
1.3.	ISO Certificate			
1.4.	Factory License			
2.	Functional Testing report by firm V&V			
2.1.	Functional Test Report (SIF0533, latest Version)			
2.2.	Functional Test Report of DMI (SIF0515, latest Version)			
2.3.	Functional Test Report of Event logger with final checksum (SIF0595, latest Version)			
3.	Functional Testing report witnessed by RDSO representative (After approval with final check sum approved by ISA)⁸			
3.1.	Functional Test Report (SIF0533, latest Version)			
3.2.	Functional Test Report of DMI (SIF0515, latest Version)			
3.3.	Interoperability tests Report (SIF0594, latest version)			
4.	Design Documents			
4.1.	System Requirement specification with clause wise compliance			
4.2.	Data modification (User Configuration) manual			
4.3.	Operating manual			
4.4.	User Manual including SRAC			
4.5.	Installation Manual with pre-installation check list including SRAC			
4.6.	Maintenance Manual including SRAC			
4.7.	Pre- commissioning checklist for SKAVACH including SRAC			
4.8.	Pre-commissioning checklist for Loco KAVACH including SRAC			
4.9.	Maintenance checklist for SKAVACH including SRAC			

⁸ If issue observed during functional testing during RDSO witnessing, then firm shall revised the software and conduct field trial & obtain ISA certification for change within 6 months from the date of approval.

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S. No.	Documents Description	Submitted / Not Submitted	Target Date	RDSO Comments
4.10.	Maintenance checklist for onboard KAVACH including SRAC			
4.11.	Failure mode effect analysis (FMEA)			
4.12.	Card wise power supply requirement			
4.13.	THR Calculation: Estimated Mean Time Between Failures (MTBF) & Mean Time Between Wrong Side Failures (MTBWSF) for each sub-system & complete KAVACH			
4.14.	The MTBF of Stationary KAVACH unit (excluding radio modems, GPS, GSM modems) shall be minimum 60,000 Hrs.			
4.15.	MTBF for the Onboard KAVACH unit (excluding RFID Reader, Radio modems, GPS and GSM modems) shall be minimum 40,000 Hrs.			
4.16.	MTBF of RFID reader as well as an RFID tag, Radio Modems, GPS and GSM modem shall be minimum 1,00,000 Hrs.			
5.	V&V Documents			
5.1.	Report containing verification and validation documents approved by the accredited validation agency.			
5.2.	Hazard log			
5.3.	PHA			
5.4.	SSHA			
5.5.	FHA			
5.6.	Reliability evaluations			
5.7.	Software evaluations (White box test report)			
5.8.	Protocol evaluations			
5.9.	GASC			
5.10.	The methodologies adopted for various tests which are to be decided based on the system design / configuration.			
5.11.	Verification & Validation of the software and hardware shall be done by the Independent Safety Assessor (ISA) as per Safety Integrity Level4 (SIL-4) of CENELEC standards or equivalent.			
5.12.	SIL 4 for functions as per SRS document (FTA document for KAVACH)			
5.13.	SIL 2 for event logging functions of onboard KAVACH			
5.14.	SIL 2 for event logging functions of stationary KAVACH			
5.15.	SIL 2 for DMI functions			
5.16.	ISA Assessment Report			

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S. No.	Documents Description	Submitted / Not Submitted	Target Date	RDSO Comments
5.17.	ISA will perform the card level & system level fail safety test and the firm shall submit the certificate and compliance of the report to RDSO.			
5.18.	Certificate issued by ISA			
5.19.	Compliance report to ISA observations (if any)			
5.20.	For Network Monitoring System the independent V&V team of OEM shall check and documentation to this effect shall be submitted to RDSO.			
6.	Field Trial			
6.1.	Passenger Field Trial Report (Absolute Block Section)			
6.2.	For Semi-high speedfor160km/h:			
6.3.	Passenger Field Trial Report (Automatic Block Section)			
6.4.	LE trials for SPAD and loop line speed controls tests			
6.5.	Testing of Unusual stoppage in block section			
6.6.	Collision scenarios			
6.7.	Collision scenarios in the vicinity of adjustment/junction tag			
6.8.	Testing of station: Manual SOS to locos with adjustment/junction tag in block section. (One loco before the adjustment/junction tag and another beyond the adjustment/ junction tag			
6.9.	Field Interoperability trial test reports			
6.10.	Operational availability report on weekly basis for passenger trial			
7.	Compliance to deficiencies and SRACS			

5.2 Approved vendor category: 1 million hours of operating time and at least two years' experience. The operating time of the loco and station are calculated separately.