Schedule 5(i)

Interlocking System (IXL)

California High-Speed Rail Authority

Standard Specifications
TSCC Specification
SPEC-0013 – Interlocking System (IXL)
Rev. 0.0

Authored:	Tomas Stary / Vincent Decanter, TCS Engineer	10/15/2025 Date
Checked:	Andrew Clapham, Train Control Lead	10/15/2025 Date
Checked:	Bruno Comperat, Deputy Director of Rail Engineering	10/16/2025 Date
Approved:	Ryan Scott, Director of Rail Engineering	10/16/2025 Date
Released:	Amit Joshi, Configuration Manager	10/16/2025 Date

Document Revision History – Interlocking System Specifications

First Edition

September 2025

Revision	Date	Revision Description
0.0	September 2025	First edition

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1 INTRODUCTION

1.1 Scope of Technical Specification

1.1.1 The scope of this Technical Specification is to define the Authority's Requirements for the Interlocking System, hereinafter: IXL.

1.1.2 This Technical Specification is based on the Authority's Design Criteria Manual (DCM) Chapter 12: Communication Systems and Train Control.

1.1.3 The functional architecture of the IXL alongside other Train Control Systems is presented in Appendix A.

1.1.4 The requirements are formulated using the following words and their meanings:

- "Shall": Indicates mandatory requirement that must be strictly implemented. Any impossibility to fulfil this requirement must be agreed through a derogation case (see change management procedure).
- "Should": Indicates preferred course of action, recommendations. No agreement of derogation is necessary, there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course - for example the same goal is reached by other solutions, which are permissible within the binding standards or documents.
- "Must": Indicates an obligation or a mandatory requirement.
- "May": Indicates a permissible course of action within the limits of the standards, but which is not mandatory to be fulfilled.

2 REFERENCE STANDARDS, NORMS AND DOCUMENTS

2.1 General

2.1.1 The TSCC Contractor shall apply the in-force standards, guidelines and specifications provided in this technical specification for all stages of the design, test, manufacture, supply, delivery, assembly, installation, testing, commissioning, training, operations and maintenance.

2.1.2 All generic standards to be used are provided in: Schedule 16.

2.2 Engineering Rules Guidelines

2.2.1 Engineering Rules shall be considered as a guideline that has been used for reference design purpose and can be adjusted by the TSCC Contractor if necessary.

2.2.2 The latest version of the following Engineering Rules shall be applied:

ID	Code	Title
[R36]	19_STS	Signaling Engineering Rules
[R37]	DCM_01	Design Criteria Manual Chapter 1: Overview
[R38]	DCM_12	Design Criteria Manual Chapter 12: Communication Systems and Train Control
[R39]	AREMA_17	AREMA Standards Chapter 17 – High-Speed Rail Systems

TABLE 25 - ENGINEERING RULES

2.3 Standards

2.3.1 The TSCC Contractor shall fully apply the following specific IXL standards in the provision of the works, the in-force standards shall be applied.

TABLE 2 – LIST OF APPLICABLE STANDARDS

ID	Code	Title
[R40]	EULYNX Baseline Set 4 Release 4	EULYNX Baseline Set 4 Release 4
[R41]	EN 50125	Railway applications - Environmental conditions for equipment - Part 3: Equipment for signaling and telecommunications
[R42]	EN 50124-1	Railway applications - Insulation coordination - Part 1: Basic requirements - Clearances and creepage distances for all electrical and electronic equipment
[R43]	EN 50121	Railway applications - Electromagnetic compatibility - Part 1: General
[R44]	EN 50129	Railway applications - Communication, signaling and processing systems - Safety related electronic systems for signaling
[R45]	TSI	Technical Specifications for Interoperability
[R46]	TSI LOC&PAS	Rolling Stock - Locomotives and Passengers TSI
[R47]	ISO 27001	Information security, cybersecurity and privacy protection — Information security management systems — Requirements
[R48]	NIST 800-53	Security and Privacy CFR 236y Controls for Information Systems and Organizations
[R49]	MIL-STD-810G	U.S. Department of Defense Test Method Standard, Environmental Engineering Considerations and Laboratory Tests
[R50]	EN 50159-1	Railway applications - Communication, signaling and processing systems - Part 1: Safety-related communication in closed transmission systems
[R51]	EN ISO/IEC 17020	Conformity assessment — Requirements for the operation of various types of bodies performing inspection
[R52]	EN 50126	Railway Applications - The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) - Part 1: Generic RAMS Process
[R53]	EN 50716	Railway Applications - Requirements for software development
[R54]	49 CFR 236 – Subparts C and H	RULES, STANDARDS, AND INSTRUCTIONS GOVERNING THE INSTALLATION, INSPECTION, MAINTENANCE, AND REPAIR OF SIGNAL AND TRAIN CONTROL SYSTEMS, DEVICES, AND APPLIANCES: Subpart C – Interlocking and Subpart H "Standards for Processor-Based Signal and train control Systems"

3 TERMS, DEFINITION AND ABBREVIATION

3.1.1 All the terms, definitions, and abbreviations are provided in Schedule 5(t) SPEC-0024 – Glossary of Terms, Abbreviations and Definitions.

4 SYSTEM DESCRIPTION

4.1 Purpose of the Interlocking System

4.1.1 The purpose of the Interlocking system is to ensure protection against the following hazardous situations:

- collision of trains;
- train derailment;
- operation mishandling by the Dispatcher.

4.1.2 The Interlocking system shall operate switch machines and shunting signals to set a safe route for each train's movement, and to ensure that any other route conflicting with the already set route is prohibited.

4.2 Interlocking System Definition

4.2.1 The Interlocking system is composed of:

- Computer Based Interlocking (CBI): Safety equipment that contains the interlocking logic which processes the route setting activity based on the TMS commands, and the control of the wayside objects. The CBI is usually composed of several racks centrally located in the OCC buildings;
- Object Controllers (OC): Electronic units that monitor and control wayside objects (e.g., switch machines, axle counter sensors). They are in technical buildings (technical rooms) or Train control equipment housings on the open line;
- Wayside Objects: All wayside objects shall be connected with CBI by means of OCs;
- Interlocking Maintenance and Diagnostic Terminal (MDT) to collect diagnostic, status, alarms and maintenance data related to the Interlocking system.

4.2.2 The CBI interface with OC shall implement EULYNX specifications [R1].

4.3 Interlocking System Operational Context

4.3.1 The Interlocking system shall enable:

- 24h service all year around;
- Management of train movements along the line with the given headway;
- Bidirectional operation on each track with same performance in both directions;
- Management of interfaces with other subsystems of railway system;
- Recording diagnostic information and alarms for maintenance purposes;

4.3.2 The Interlocking system shall comply with the operational rules applicable on the CHSR line and shall allow safe movement of all train configurations defined for CHSR line at maximum design speed.

4.3.3 The Interlocking system shall be deployed over the entire railway network on the CHSR line, managing all types of railway infrastructure, e.g., main line and Facilities.

Note to reader**: Definition of Facilities is provided in Chapter **4.3.

4.3.4 The Interlocking system shall ensure:

- Main route, shunting route and call-on routes management on the CHSR main line under operation from Main line TMS located in Fresno OCC;

- Route management between CHSR main line and transfer tracks of Facilities (and vice versa) under operation of main line TMS or the Facilities workstations, when authorized;
- Route management in Facilities operated from Facilities workstations, including on transfer tracks.

5 SYSTEM REQUIREMENTS

5.1 General Requirements

5.1.1 The Interlocking system shall be designed in accordance with the requirements described in this specification, others relevant technical specifications and the rest of CHSR documentation.

5.1.2 The interlocking logic associated with the main line operations (e.g., operations controlled by the TMS system located in the OCC) shall be implemented in a centralized interlocking core, that shall be a CBI type.

5.1.3 The Interlocking system shall be able to accommodate a high centralization capacity in such a way that one CBI location shall be sufficient to control all the train control system infrastructure of the CHSR line.

5.1.4 The CBI shall be in an equipment room at the OCC in Fresno.

5.1.5 The object controllers shall be installed in one of the following configurations:

- Gathered in technical buildings/rooms connected to wayside objects using long tail cables, or long field cables and short tail cables (interfaced with a junction box);
- Near wayside objects, in dedicated object controller housings (train control equipment housings) dispatched along the track and connected to wayside objects using short tail cables.

5.1.6 The position of equipment and Train control equipment housings, and geographical boundaries controlled by each housing are to be designed and defined by the TSCC Contractor and shall be submitted to the Authority for approval.

5.1.7 The link between OCs and wayside objects shall consist of a direct link through copper cable, fiber optic cable or equivalent. This link shall be designed and supplied by the TSCC Contractor.

5.2 Environmental Condition Requirements

5.2.1 Refer to Technical Contract Requirements for general environmental requirements.

5.2.2 The additional following environment requirements apply to the Interlocking system:

- The CBI shall be installed in OCC equipment room with climatic control (air-conditioning);
- OCs shall be installed either in train control equipment housings along the track or in technical buildings/rooms (with climatic control).

5.2.3 For each implementation, equipment housing shall be proposed by the TSCC Contractor according to environment and approved by the Authority. The values for climatic conditions to be considered for all the OCs are those applicable to train control equipment housings.

5.2.4 Train Control equipment shall be placed in locations where they do not infringe people's passage.

5.2.5 Train Control wayside equipment shall be designed to ensure adequate protection from rodent actions.

5.2.6 The Interlocking system equipment (CBI, OC…) shall meet requirements for operation in cubicles, Train control equipment housings, and buildings as defined in standard EN 50125 Part 3.

5.2.7 The Interlocking system shall be compatible with the operation of the 2×25 kV AC Overhead Contact System (OCS). OCS and high voltage traction equipment shall not interfere with the operation of interlocking system equipment, requirements from standard EN 50124-1 shall be respected.

5.2.8 The Interlocking system, when installed along the track, shall not be disturbed by the operation of the 2×25kV AC OCS.

5.2.9 In addition, the interlocking system shall not be disturbed by High Voltage Power Lines parallel to CHSR line.

5.2.10 The Interlocking system shall fulfil requirements from standard EN 50121 series and standards related to EMC, emissions, and immunity.

5.2.11 The Interlocking system shall be compliant with EN 50124-1 for insulation coordination of wayside equipment.

5.2.12 The Interlocking system equipment shall be capable of resisting an overvoltage from lighting to a maximum of 2kV.

5.2.13 To limit the touch voltage to a safe level, all the accessible metallic parts that eventually can reach dangerous voltage, shall be connected to the return circuit by means of local grounding systems.

5.2.14 Ventilation

5.2.14.1 Natural ventilation shall be preferred to forced ventilation.

5.2.14.2 If forced ventilation is necessary:

- A breakdown in the ventilation system shall be reported to the maintenance team;
- The ventilated equipment must be fully functional at least three days after a ventilation breakdown.

5.3 Operation Requirements

5.3.1 A unique and dedicated interlocking shall manage mainline, passengers' stations MOWS (Corcoran), TCF and sidings. This interlocking shall be in the equipment room in Fresno OCC. This interlocking is called Mainline interlocking in this document.

5.3.2 Dedicated IXL(s) (i.e. physically segregated from the mainline IXL) shall manage Light and Heavy Maintenance Facilities (LMF&HMF) as well as Maintenance of Way Facilities (MOWF). Depending on the configuration and location of these Facilities, the same interlocking could manage multiples facilities (for example Fresno's MOWF and HMF could be managed by a single IXL). But each Facility (except TCF) will have its own TMS workstations and local operator to manage the area under its responsibility.

5.3.3 When a train is requested to enter the main line from Fresno's facilities (except TCF), the Local Control shall request authorization from OCC.

5.3.4 The list of area types, type of operation and associated interlocking logic is summed up in the table below.

Area	Type of Supervised Operation	Interlocking Logic
Maintenance Of Way Facility (MOWF) in Fresno	Operated by a dedicated MOWF operator and from dedicated TMS workstation	Dedicated interlocking for Facilities, it could be mutualized with LMF/HMF interlocking
Train Certification Facility (TCF) in Fresno	Operated from Main line TMS workstation in OCC	Main line interlocking
Maintenance Of Way Facility Siding (MOWS) in Corcoran	Operated from Main line TMS workstation in OCC	Main line interlocking
Light Maintenance facility (LMF)	Operated by a dedicated LMF operator and from dedicated TMS workstation	Dedicated interlocking for Facilities, it could be

Area	Type of Supervised Operation	Interlocking Logic
		mutualized with MOWF/HMF interlocking
Heavy Maintenance Facility (HMF)	Operated by a dedicated HMF operator and from dedicated TMS workstations	Dedicated interlocking for Facilities, it could be mutualized with MOWF/LMF interlocking
Transfer tracks (Transfer tracks are used to route trains in or out of some Facilities or private sidings)	Operated from Main line TMS workstation in OCC or, when authorized, by Facilities workstation.	Boundary between Main line interlocking and Dedicated interlocking for Facilities
Main tracks and passing loops for stations are part of the main line and shall not be considered as a Facilities. (Tracks not used for permanent shunting purposes, except for coupling/decoupling or reversing towards dead end track).	Operated from Main line TMS workstation in OCC	Main line interlocking

TABLE 2: AREA AND OPERATION TYPES

5.3.5 Shunting operations shall be managed with shunting signals supporting train movement in ETCS SH mode.

5.3.6 The TSCC Contractor shall propose a train control solution without shunting signals when technically possible.

5.3.7 For Facilities operated without RBC supervision (such as MOWF, LMF, HMF), the CBI in Facilities shall be designed to ease a potential evolution to RBC supervised operations in the future. When interfacing a future RBC to this CBI, impact on the CBI shall be minimized.

5.3.8 TCF will be equipped with mainline ETCS (ETCS Marker Boards, balise, RBC coverage) to test the trains.

5.3.9 Depending on the proposed interlocking solution from the TSCC Contractor, on the track configuration and on the operational needs, the transfer tracks shall either be managed by the main line interlocking or by the dedicated interlocking of the Facilities.

***Note to reader**: Dedicated tracks separating the main line from Facilities shall enable any train movement from the main line to the Facilities and from the Facilities to the main line. Those tracks are called "transfer tracks".*

5.3.10 Any train movement between the main line and transfer tracks of a Facilities shall be supervised and controlled with the same level of safety as any train movement on the main line. This level of safety shall be SIL4.

5.3.11 The Facilities CBI shall, at least, interface with:

- Facilities TMS / workstations
- Main line CBI

- Object Controllers for:
  - Axle counters,
  - Shunting signals when relevant,
  - Switch machines and derailers,
  - HDEWS when relevant,
  - Other equipment if required.

5.4 Functional Requirements

5.4.1 The Interlocking system shall perform, at least, the following functions:

- Check and evaluate the command received from the TMS;
- Compile status information and report fault indication of wayside equipment;
- Exchange information with adjacent interlocking (between mainline IXL and Facilities IXL's);
- Ensure route interlocking and route protection (Route setting, locking, detecting and release …);
- Ensure time of operation locking
- Ensure out of correspondence alarms/controls for switch detection
- Ensure flank protection and control
- Ensure approach locking, track deadlocking, switch deadlocking, fouling controls for transfer tracks at facilities
- Exchange the information with ETCS wayside subsystem (bi-directional) and transmit route status to the ETCS wayside subsystem (as per EULYNX SCI-RBC specification);
- Manage and perform emergency commands (such as emergency route release, signal blocking, signal group replacement);
- Manage track possession activation;
- Manage normal route, shunting route, Call-on route;
- Manage fleeting operations;
- Ensure Interlocking functions as per CFR 236 [R15]
- Ensure normal and degraded modes controls and operation
- Manage Interlocking diagnostic information and alarms.
- Auto-normalization controls for switch machines, when relevant
- …

5.4.2 The Interlocking system shall set, lock, monitor and release route for train movements.

5.4.3 The Interlocking system shall allow sectional route locking and sectional route release of the routes, section by section, to allow compatible train movements as soon as possible.

***Note to reader**: A signaling section corresponds to a portion of track between 2 neighboring axle counters.*

5.4.4 The Interlocking system shall manage route cancellation features. The safety conditions to cancel the route shall be defined by the TSCC Contractor.

5.4.5 The RBC and CBI shall cooperate to manage approach locking and route cancellation/release (cooperative shortening of MA).

5.4.6 The route supervision function shall ensure continuous supervision of all routes, including the status of train detection sections, the position of the different turnouts, derailers and their locking states, maintenance work protection, and, when required, ancillary system alarms detection.

5.4.7 The Interlocking system shall be capable of controlling and monitoring at least the following wayside objects and monitoring their status:

- Switch Machines;
- Derailers;
- Signals;
- Axle counters;
- Staff Protection System;
- Other devices, if required, such as HDEWS.

5.4.8 **Computer Based Interlocking (CBI)**

5.4.8.1 A railway signalling CBI is a functional safety programmable controller with a safety integrity level capability of SIL 4 (as defined in EN 50129).

5.4.8.2 Main line CBI shall be SIL 4.

5.4.8.3 Facilities CBI may be SIL 4 or lower.

5.4.8.4 Lower SIL level to save costs may be used to Facilities CBI only after positive evaluation in the risk assessment from the TSCC Contractor.

5.4.8.5 The TSCC Contractor shall conduct a safety study to determine the appropriate safety level for each facility CBI.

5.4.8.6 The CBI equipment shall provide the following features:

- Application logic;
- Programming, debugging, and testing tools for the application logic both in creation of an installation and during maintenance of the installation;
- Evaluation of the application logic;
- Interfaces to equipment;
- Secure safe response according to the status of the supervised objects;
- Defined on-line support tool functionality.

5.4.9 **Start-up**

5.4.9.1 At start-up, the Interlocking system shall set all outputs to their restrictive states.

5.4.9.2 All protection shall be set during the start-up, and any active protection set prior to the start-up of the interlocking system shall be restored after the start-up. If the status of the protection prior to the start-up cannot be determined with the appropriate safety integrity level (SIL4), the protection shall be active by default.

5.4.9.3 The start-up of the Interlocking system shall take no longer than 3 minutes and shall not require any operator intervention to initialize the Interlocking system.

5.4.9.4 The Interlocking system shall not process any command from the TMS during start-up.

5.4.9.5 The operator shall be informed when the start-up phase is on-going and when the timer has elapsed.

5.4.10 ETCS Overlap and Interlocking

5.4.10.1 On the CHSR Main line, the nominal overlap shall be 70 meters (refer to ETCS Technical Specification). The Interlocking system may implement detection points to manage different overlap values at specific locations. The specific locations shall be detailed at specific application requirements level.

***Note to reader**: In accordance with ETCS Technical Specification, the ETCS design will detail the need to use different overlaps (including longer overlaps).*

5.4.11 Shunting Movements in Station

5.4.11.1 Shunting is an activity where trains are prepared, moved, split, or combined in preparation for service.

5.4.11.2 The shunting movements in a station could be performed by means of ETCS Shunting (SH) mode. In this case several shunting areas can be defined for each station to allow shunting operation only inside a selected shunting area. The dispatcher shall set up a pre-defined Temporary Local Shunting Area to authorize shunting movement in the area. The interlocking system will process the TMS request and will inform the ETCS to authorize the shunting mode inside the selected shunting area.

5.4.12 Call-on route

5.4.12.1 Certain locations are permitted to allow more than one train into a single section, e.g. to join trains or enable 2 trains to use one platform. The movement of the second train into an occupied section is authorized by setting a "call-on" route.

5.4.12.2 The Interlocking shall manage call-on routes for the trains in ETCS On-Sight mode allowing these trains to entry in occupied sections.

5.4.13 Individual turnouts local control

5.4.13.1 Long turnouts that are operated by multiple switch machines (if used) require local control to electrically move the multiple switch machines using a local control panel. The local control panel shall be located at the side of the track and contain electrical switch(s). The trained field operator with the correct security access level can use such a local control panel.

5.4.13.2 The field operator shall request and obtain permission from the TMS for the local operation in the time slot of relevant possession.

5.4.13.3 After TMS authorization and when the safety and operational conditions are met, the interlocking shall allow the individual turnout to be set in local mode so field operator can control the turnout locally.

5.4.13.4 When the field operator activates the local turnout control, the interlocking shall inform the TMS of the respective status of the turnout and shall protect the turnout area from incoming train and discard any command from the TMS involving the individual turnout.

5.4.13.5 The Interlocking shall not authorize the setting of any route that includes a turnout which is in local mode.

5.4.14 Staff Protection

5.4.14.1 The Staff Protection function shall allow protection of maintenance staff or protection of equipment in case of unavailability of a piece of track (for works reasons, hazard on the section, environmental circumstances…).

5.4.14.2 The Staff Protection function shall be a SIL 4 function.

5.4.14.3 The following means shall be used to ensure the Staff Protection:

- Elementary protection sections:
  - The CHSR railway network shall be divided into elementary protection sections consisting of one or few track clearance detection sections (subject of review and approval by the Authority);
  - The activation of the elementary protection section shall exclude this section from the train traffic.
- Engineering Possession Management:
  a. A list of preconfigured and predefined engineering possessions shall be available to the TMS dispatcher;
  b. The TMS dispatcher shall be able to select Engineering Possessions from this list and activate it. Maintenance work protections shall be set automatically by activating the corresponding elementary protection sections.
- Staff Protection wayside device:
  c. Staff protection wayside device shall allow the maintenance staff to set up their own protection in addition to the engineering possession;
  d. Staff protection wayside device shall allow the maintenance staff located along the track to confirm the protected status (activation) of the elementary protection section.

5.4.14.4 The TSCC Contractor shall develop the Staff Protection wayside device to be used in conjunction with the Possession Management by the TMS, to mitigate operators' error of setting up an incorrect engineering possession.

5.4.14.5 The activation/deactivation of an elementary protection section shall be done under a commonly agreed operational procedure between operator and wayside maintenance chief engineer.

5.4.14.6 Clear indication of the track layout divided into elementary protection sections as well as the status of each elementary protection section shall be provided.

5.4.14.7 The Staff protection wayside device shall be designed to prevent unintentional setting or un-setting of the protection.

5.4.14.8 The activation of an elementary protection section shall be considered by the CBI as an occupation of the detection area covered by the elementary protection section.

5.4.14.9 A section of track shall be considered protected if the corresponding elementary protection section is activated from the Staff protection wayside device or if a request from TMS has been made and confirmed.

5.4.14.10 Elementary Protection sections shall correspond to:

- Every block section limit (Marker Board) in the open line;
- At dedicated access point for maintenance purpose in station areas.

5.4.14.11 Drawings indicating without ambiguity elementary protection sections shall be supplied by the TSCC Contractor.

5.4.15 **Data Recording**

5.4.15.1 The Interlocking system shall record any necessary information for maintenance purposes and for incident investigation. The information shall be directly accessible to CHSR staff in a readable format and shall be provided with a user manual that allows the understanding of the downloaded information.

5.4.15.2 The Interlocking system shall record at least the following information:

- All changes for each input and output of the Interlocking system. Each record shall be time and date stamped;
- The complete status of all information at start-up and regular intervals;
- The event in the record file when the event recorder starts recording, time or date is adjusted and when event recorder stops recording with a date and time stamp;
- All interlocking system equipment alarms or warning messages with a date and time stamp.

5.4.15.3 Separate record files for manageable geographic regions of the interlocking system installation shall be stored. Every record file shall include a reference to the site-specific data name.

5.4.15.4 A minimum of 90 days of recorded information shall be available.

5.4.15.5 Records shall be stored in non-volatile media. The non-volatile media shall be able to restore the complete information without damage for a minimum duration of 6 years.

5.4.15.6 The first line maintainer shall have facilities to select, view and export recorded events to either a removable medium or another system. The use of these facilities shall not interrupt or delay the recording and timestamping of events. The implementation of this facility shall consider the cybersecurity constraints.

5.4.15.7 If the event recorders' power is lost, then all events shall remain recorded except for events occurring in the preceding 1 minute which may be lost.

5.4.15.8 The event recorder shall automatically restart and begin recording after the mains power is applied to the event recorder.

5.4.15.9 The start-up delay for the event recorder shall be less than or equal to the start-up delay for the equipment that it is recording information for.

5.4.16 **Replay**

5.4.16.1 The Interlocking system shall provide a replay feature which uses the information recorded by the event recorder.

5.4.16.2 The replay facility shall allow the commencement of replay at any 10 min time interval.

5.4.16.3 Replay controls shall be modelled on the controls for playing a video. For example, play, fast forward, slow forward, fast reverse, slow reverse, pause and stop. Fast speeds shall range from 2 to 30 times the normal speed. Slow speeds shall range from 0.5 to 0.1 times the normal speed. At least two intermediate speed options shall be provided in each range.

5.4.16.4 The replay display will be used by people that normally view signalling equipment status on a TMS display. The replay display states, and layout shall be designed so that it is unlikely that these people misinterpret the information when it is viewed on an intermittent basis (less than once every six months).

5.4.17 **Maintenance Support**

5.4.17.1 The interlocking Maintenance and Diagnostic Terminal (MDT) shall collect incidents, alarms and any maintenance information related to CBI, Object Controllers, wayside objects (including switch machines) and related interface.

5.4.17.2 Object controllers and CBI shall interface the MDT using SDI and SMI Eulynx Baseline 4 Release 4 (or higher) specifications.

5.4.17.3 The MDT shall enable equipment malfunctions and failures to be identified at a line replaceable unit (LRU) level.

5.4.17.4 Any interlocking system alarms indicating a failure that causes or are likely to cause an operational delay shall be configurable to be sent to the dispatcher HMI interface to advise of the failure.

5.4.17.5 The different interlocking system components shall provide active indications of correct operation without the use of additional equipment.

5.4.17.6 The interlocking Maintenance and Diagnostic Terminal (MDT) shall provide the following maintenance functionality to support the maintainer performing corrective maintenance, preventive maintenance, and investigation of incidents:

- Maintenance display that shows the status of the Interlocking system and interfaced objects and related associated telecommunications links.
- Management of the display, acknowledgement and archiving of alarms and warnings for the CBI equipment, related equipment, and associated telecommunications links.
- Operation of all control, monitoring and interrogation functions provided as part of the interlocking system equipment for use by the maintainer.
- Facilities required by first line maintenance personnel to configure the Interlocking system and interfaced objects for the specific site and usage as part of corrective maintenance.

5.4.17.7 The interlocking Maintenance and Diagnostic Terminal (MDT) shall provide remote facilities for uploading OC configurations.

5.4.17.8 MDT connections shall fulfil the cyber security requirements defined in the Cybersecurity technical specification.

5.4.18 Track Vacancy Detection

5.4.18.1 From a signaling point of view, the CHSR line will consist of block sections separated by marker boards and axle counters.

5.4.18.2 The CHSR line shall use fixed block working operation without lineside signals.

5.4.18.3 Block sections shall be designed for the required headways and operation performance.

5.4.18.4 Block sections shall be designed for bidirectional running on all tracks. Both directions of traffic shall reach the same level of performance.

5.4.18.5 Additional informative guidance (engineering rules) for axle counter placement is described in the document **"**Signaling Engineering Rules".

5.5 Performance Requirements

5.5.1 **Capacity**

5.5.1.1 A CBI shall be able to control at minimum all OC necessary for all wayside objects of the whole EOS line.

5.5.1.2 A provision of 50% shall be provided (in terms of wayside objects management and space in technical buildings / Train Control Equipment Housing) for potential future network extension.

5.5.2 **Safety Requirements**

5.5.2.1 The Interlocking system shall comply with the safety requirements defined in the TSCC Safety documentation.

5.5.3 **RAM Requirements**

5.5.3.1 The Interlocking system shall comply with the RAM requirements defined in Schedule 1 – Safety, Security and RAM Requirements.

5.6 Security and Cybersecurity Requirements

5.6.1 The Interlocking system shall be in full compliance with CHSR cybersecurity controls defined in Cybersecurity Technical Specification.

5.6.2 One or more System Owners (as defined in the Cybersecurity Technical Specification) shall be nominated as the accountable entity that shall be the risk owner of all cybersecurity risks associated with interlocking, or individual components of interlocking.

5.6.3 Safety critical interlocking traffic shall be protected from spoofing or tampering, all messages between interlocking systems shall be authenticated.

5.6.4 The System Owners that are nominated to own cybersecurity risks associated with interlocking systems shall ensure that appropriate resources are available and attend threat modelling workshops and risk assessment activities.

5.6.5 The System Owners that are nominated shall ensure that security requirements are embedded into the procurement process for all interlocking components.

5.6.6 System Owners shall demonstrate how cybersecurity requirements are being met by the interlocking systems and co-engineer solutions with the Cybersecurity Lead where specific controls cannot be implemented.

5.6.7 EULYNX communication protocols shall be evaluated to ensure that the most secure option that achieves the functional and safety requirements is selected and implemented in compliance with the CHSR Cybersecurity Technical Specification.

5.7 Wayside Object Requirements

5.7.1 Axle Counters

5.7.1.1 The mainline train detection system shall be based on axle counter technology.

5.7.1.2 Axle counters shall have a safety integrity level capability of SIL 4 (as defined in EN 50129).

5.7.1.3 The train detection system shall be compatible with the following characteristics:

- Electrical 2x25 kV trainset traction;
- Operation speeds up to 354 km/h (220 mph) (note: During testing phase, axle counters shall support a speed up to 390 km/h (242 mph) (speed+10%));
- Wheel characteristics, geometry and Axle distance as defined in “LOC&PAS / Interface between control-command signaling wayside and other subsystems TSI” document;
- All rail profiles used on CHSR network;
- Rail temperatures specified for CHSR line.

5.7.1.4 The Track Vacancy Proving equipment shall allow operation of 205m EMUs and 410m double EMUs.

5.7.1.5 The length of the trainset will be no more than 205 m (672.6 feet). The overall length of the double-traction train for operational purposes will be no more than 410 meters (1,345.2 feet).

5.7.1.6 As per Eulynx Specification SCI-TDS, the train detection system shall report to the CBI at least the following TVP occupancy status: Vacant, Occupied, Disturbed.

5.7.1.7 As per Eulynx Specification SCI-RBC, the CBI shall then report to the RBC the following TVP section status: Section occupied, Section vacant, Section failed.

5.7.1.8 The train detection system, in addition, shall be able to indicate at least the following conditions:

- Proper operation;
- Fail Safe State;
- Temporary interruptions;
- Isolated, e.g., intentionally not used.

5.7.1.9 The axle counter shall define a track section as occupied as soon as the first axle of the train passes the axle counter border.

5.7.1.10 The equipment shall be able to handle train movements in both directions.

5.7.1.11 The train detection system shall operate correctly and detect any type of trainsets (passengers, freight, maintenance etc.) permitted to operate on the CHSR network and to circulate on the line whatever the speed of movement is.

5.7.1.12 For each axle counter installation, the environmental conditions under which axle counter is required to operate shall be considered.

5.7.1.13 The train detection system shall not be disrupted by electromagnetic interferences from external sources and shall be compliant with the EMC requirements either indoor or outdoor equipment installation.

5.7.1.14 Wheel sensors cables shall be laid separately from electric power lines, motors lines etc., where the immunization of the field equipment and cabling requires this, because of EMC.

5.7.1.15 The train detection system shall be compatible with the ballast and slab type of track.

5.7.1.16 The axle counters shall be mounted on rail without drilling.

5.7.1.17 The axle counters deployed shall be compatible with different IXL platforms and SIL 4 IXL protocols in the market and shall support EULYNX.

5.7.1.18 The Axle counter solution designed and proposed by the TSCC Contractor shall be compliant with general CHSR cybersecurity policies and in accordance with, at least, ISO 27001 and NIST 800-53 security standards.

5.7.1.19 The Axle counter sub-system shall include software within the Interlocking system or a specific one, for the management of the equipment.

5.7.1.20 Changing the Axle counter counting sensor should not require digging up cable between Axle counter sensor and junction box.

5.7.1.21 The axle counter tail cabling should not be buried.

5.7.1.22 It shall be possible to update the Axle counter software remotely.

5.7.1.23 It shall be possible to initiate an axle counter Reset/Restore from the TMS (in case of miscounting for example). The Interlocking system shall process the TMS request and evaluate the safety conditions to restore the section.

5.7.1.24 Feature/process for reset of axle counters shall ensure safety of train operation by acquiring evidence of the non-occupation of the corresponding track section prior to allowing restoration of nominal operation.

5.7.1.25 Interface between axle counter evaluator (i.e. Axle counter Object controller) and the CBI shall be based on SCI-TDS Eulynx Baseline 4 Release 4 (or higher) specification.

5.7.1.26 Interface between axle counter evaluator and the MDT shall be based on SDI-TDS and SMI-TDS Eulynx Baseline 4 Release 4 (or higher) specification.

5.7.1.27 In case a default appears on an axle counter sensor, a feature or procedure shall be developed to restore nominal train operation, without requiring maintenance staff in the field.

5.7.1.28 Intelligent fault tolerance measures shall be applied to improve Reliability and Availability of the axle counter system.

5.7.2 Staff Protection wayside device

5.7.2.1 This chapter specifies the technological requirements for the Staff Protection wayside device used in "Staff protection function" described in section 4.4.14.

5.7.2.2 The staff protection wayside device may be based on ruggedized portable tablets with communication supported by FRMCS.

5.7.3 Switch Machine

5.7.3.1 There shall be several types of turnouts for the following 3 different diverging track speeds:

- Main line crossovers: 80 mph;
- Stations: 60 mph;
- Sidetracks: 50 mph.

5.7.3.2 The TSCC Contractor shall be responsible for choosing the correct switch machines for the traversal speed.

5.7.3.3 There shall be provision of support system facilities for the switch machines at turnout and crossover locations for TCS and OCS sub-sectioning support (Controller, LV feeding, telecom link…)

5.7.3.4 Only components with proven service records for application on track with at least the same or higher speed and axle load, and a minimum of 5 years' service on such conditions, shall be considered.

5.7.3.5 Switch machines shall comply with a design life of at least 30 years.

5.7.3.6 Switches, swing nose crossing (if used) shall be equipped with:

- Locking devices;
- Devices enabling to detect whether movable components lay in correct required position and are;
- correctly locked.

5.7.3.7 Switch position detection shall be failsafe and be designed to meet availability requirements.

5.7.3.8 Switch machines shall be compatible with the use of magnetic braking systems for emergency braking.

5.7.3.9 Switch machines shall be equipped with devices for local switching.

5.7.3.10 Protection class shall be IP54, IP55, or IP67 based on environment (higher IP rating preferred).

5.7.3.11 Maximum operating time shall be lower than 5 seconds (faster operation preferred for high-speed lines).

5.7.3.12 Condition monitoring shall be used to offer predictive rather than corrective maintenance.

5.7.3.13 High speed switch machines shall be non-trailable.

5.7.3.14 Switch machines in Facilities may be trailable, depending on operational requirements.

5.7.4 Shunting Signals

5.7.4.1 On tracks located in permanent shunting areas in Facilities and in temporary shunting areas in mainline stations, dwarf shunting signals shall be provided by the TSCC Contractor.

5.7.4.2 The shunting signals shall be dwarf signals with appropriate aspects. The TSCC Contractor shall develop and approve the design of the shunting signal with the Authority.

5.7.4.3 The TSCC Contractor shall develop and approve the color scheme of the shunting signal with the Authority.

5.7.4.4 The light source used for signal aspects shall use LED technology.

5.7.4.5 The light source used for signal aspects shall appear to the observer to be circular in shape.

5.7.4.6 Signals shall be positioned to give drivers an approach view for a minimum sighting distance and a minimum reading time that shall be evaluated by the TSCC Contractor. Sighting distance shall be considered with respect to the view of the whole signal. Where a signal can be approached from more than one line, the minimum reading time shall be achieved on all approaches.

5.7.4.7 There shall be no interruption of the driver's view of a signal during the required reading time which implies an unacceptable risk of the driver disregarding or misreading the signal.

5.7.4.8 When the LED unit is broken, the signal failure message shall be sent to interlocking. A failure indication of a signal shall state which signal unit contains a broken LED unit. If a signal becomes "dark" due to a breakage of the LED unit, this shall send a signal dark indication.

5.7.4.9 The failures in signal lamp circuits shall cause a failure message. These failures include a short circuit between the wires of the signal circuits, an earth leakage and an external voltage caused by e.g., a short circuit between the wires.

5.7.4.10 The lamp circuits included in the aspects that allow proceeding shall be furnished with 2-pole disconnection. Also, short circuits in an LED unit circuit shall be indicated as a failure. When the lamp of "proceed" aspect is broken, the signal shall be set to "stop" aspect.

5.7.4.11 The LED unit must be US-approved.

5.7.4.12 There must be a marking to indicate the type, version, and serial number of the LED unit.

5.7.4.13 There must be a marking to indicate the LED unit manufacturer and the date of manufacturing.

5.7.4.14 There must be a warning text if it is forbidden to look directly at the LED unit's light beam.

5.7.4.15 All mandatory classifications that are marked on the LED unit must be easily detectable and clearly visible.

5.7.4.16 LED units' classification for casing (including inlet sleeve, grommet, and shield case) must be at least IP54.

5.7.4.17 There must not be any light emitted from the back of the signal with LED units, when LED unit is activated.

5.7.4.18 LED units shall not vibrate mechanically in a way that is observable to a driver of a passing train.

5.7.4.19 The elements of the LED unit should be arranged so that a fault in one element or in a group of elements does not have a significant effect on the distribution or the light intensity of the illuminated area.

5.7.4.20 The LED unit must not display a wrong aspect, because of reflection from other light sources or background lighting.

5.7.4.21 The LED unit is 'failed' if its luminous intensity is less than 50% of the original intensity.

5.7.4.22 The luminous intensity of the LED unit must not decrease more than 50% after 100 000 hours in use.

5.7.4.23 LED units shall be equipped with overvoltage protection. It must be possible to check visually if the overvoltage protector is damaged.

5.7.4.24 A commercially available overvoltage protector component must be used for overvoltage protection. The overvoltage protector must function before the overvoltage does any harm to any other components.

5.7.4.25 Maintenance operations shall be facilitated and from a safe area. LED replacement shall be performed from the back of the signal.

5.7.4.26 Interface between shunting signals object controller and the CBI shall be based on SCI-LS Eulynx Baseline 4 Release 4 (or higher) specification.

5.7.4.27 Interface between shunting signals object controller and the MDT shall be based on SDI-LS and SMI-LS Eulynx Baseline 4 Release 4 (or higher) specification.

Derailers

5.7.5 The TSCC Contractor shall analyze the track layout and location of the dead-end tracks/trap points and perform a risk assessment to evaluate the need for additional derailers. In such case, the TSCC Contractor shall define, provide and install derailers.

5.7.6 Derailers or dead-end tracks are used to protect main railway lines from unauthorized vehicles moving onto them from sidings or branch lines. Either of these track arrangements may lead the vehicles into a sand drag or safety siding, to safely stop them after they have left the main tracks.

5.7.7 An unauthorized movement may be due to a runaway wagon or may be a train passing a Marker Board (MB) at danger. When a MB controlling passage onto a main line is set to "danger", the derailers are set to derail any vehicle passing that MB. Interlocking shall make sure that the MB cannot allow passage onto the main line until the trap points or derailers have been aligned to ensure this movement can take place.

6 INTERFACES

6.1 General Requirements

6.1.1 Interfaces are classified as below:

- Third Party interfaces: interfaces between TSCC systems and systems provided by Third Party (excluding CHSR contractors);
- External interfaces: interface between TSCC systems and systems provided by CHSR contractors (Civils Packages, Stations contractor, Facilities contractor, Solar PV and BESS contractors);
- Internal interfaces between systems within the TSCC scope.

6.1.2 The TSCC Contractor shall develop design considering the identified Third Parties, External and Internal interfaces to ensure the required functionalities and performance described in this specification.

6.1.3 The TSCC Contractor shall, if necessary, propose any additional interfaces required to ensure the functionalities and performance described in this specification.

6.1.4 The TSCC Contractor shall achieve Interoperability by systematically identifying the interfaces between operations and maintenance, railway systems, trainsets, infrastructure, stations, and track.

6.1.5 The TSCC Contractor shall achieve interoperability by also proactively managing the interfaces between the various System and Sub-System elements.

6.2 External Interfaces – trainsets

6.2.1 The TSCC Contractor shall ensure compatibility of trainsets detection systems as per [R46] Rolling Stock - Locomotives and Passengers TSI.

6.3 External Interfaces – facilities contractor

6.3.1 The TSCC Contractor shall install all CBI equipment in the OCC and facilities being provided by the facilities contractor.

6.3.2 The TSCC Contractor shall provide to the facilities contractor:

- Equipment dimensions
- Equipment clearances requirements
- Equipment mounting and fixings requirements
- Cable routes/containment requirements
- Equipment loadings
- Installation and maintenance requirements
- Equipment heating loads
- Equipment cooling loads
- Equipment hydraulic requirements

6.3.3 To be provided by facilities contractor to accommodate the TCSS equipment installation and operational/maintenance requirements:

- Room dimensions and layouts
- Room facilities (Plumbing, HVAC, Lighting, Fire Protection Systems, Doors, electricity)
- Room raised floor system
- Delivery access routes.
- Maintenance access routes

6.4 Internal Interfaces

6.4.1 **Interface with Tracks system**

6.4.2 **Interface with TMS**

6.4.2.1 These interfaces shall be redundant and shall comply with the EULYNX set of specifications (RaSTA protocol, SCI-CC and SCI-RBC).

6.4.2.2 The Interlocking system shall be able to communicate with the main line TMS and, when relevant, to a local TMS for Facilities.

6.4.2.3 Functional data that is transferred through the link between a TMS shall be configured through the data configuration process by the data configuration tool.

6.4.3 **Interface with interlocking (CBI)**

6.4.3.1 RBC and CBI shall operate in the same TCS domain as depicted in the HSR operational context.

6.4.3.2 RBC shall have a redundant interface with CBI via the transmission network (DCN).

6.4.3.3 The interface between RBC and CBI shall be based on the Standard Common Interface SCI-RBC of EULYNX Baseline Set 4 Release 4, which provides a common set of Messages and Commands (Orders)

6.4.3.4 RBC shall be able to receive from CBI the following set of Messages based on the EULYNX standard interface:

- Signal status;
- Switch status;
- TVP section status (axle counter system);
- I/O generic element status: alarms, any other possible alarm received from the detection devices;
- Emergency Stop Area (ESA) status;
- Local Shunting Area (LSA) status;
- Working Area (WA) status;
- Route status.

6.4.3.5 [Note: in an ERTMS/ETCS L2 domain it may be the status of the “virtual signal” associated to an ETCS marker board]

6.4.3.6 RBC shall be able to send to CBI the following set of Messages based on the EULYNX standard interface:

- Train data;
- Flank Protection status;
- Signal cancelling reply;
- Signal occupation;
- Route cancelling reply;
- Route occupation.

6.4.3.7 RBC shall be able to receive from CBI the following Commands based on the EULYNX standard interface:

- Signal cancelling;
- Route cancelling.

6.4.3.8 RBC shall be able to send to CBI the following Commands based on the EULYNX standard interface:

- I/O generic element control;
- Signal control;
- Signal overlap control;
- Route control.

6.4.3.9 Any additional message or command that for operational needs must integrate the previous list shall be exchanged via the EULYNX interface, if feasible, otherwise through a different safe communication interface.

6.4.3.10 The full set of messages/commands exchanged between RBC and CBI shall be defined during the design phase of TSCC Contractor.

6.4.4 Interface with Hazard Detection and Early Warning System (HDEWS)

6.4.4.1 The interlocking system may have an interface with HDEWS to trigger a safety response in the event of an external hazard (such as unexpected obstacle on the track, flood, …).

6.4.4.2 Architecture of the interface between the interlocking system and HDEWS shall be determined by the TSCC Contractor to meet the safety and availability targets.

6.4.4.3 CBI shall interface the alarms raised by the Hazard Detection and Early Warning detectors via direct interface, or TMS depending on the outcome of the Hazard Analysis that shall be performed to define the level of mitigation required.

6.4.4.4 The complete list of safety hazards and HDEWS to be interfaced with the interlocking shall be defined by the TSCC Contractor during detailed design and safety analysis.

6.4.5 Interface with Digital Communications Network (DCN)

6.4.5.1 The Interlocking systems shall have redundant interface with the DCN to ensure secure and reliable transport of Interlocking data and to provide resilient interconnection between all CBI and Object Controllers

6.4.5.2 Eulynx protocol (i.e. RaSTA protocol as described in Eulynx set of specification shall be implemented between CBI and OCs, between CBI and adjacent CHSR CBIs, between CBI and RBC and between CBI and TMS (i.e. apply for each SCI type interface).

6.4.6 Interface with Wireless Communication Systems (WCS)

6.4.6.1 The WCS shall provide wireless communication between Trackside Worker Protection Devices, that are in a handheld ruggedized tablet form factor, and the Interlocking System. The FRMCS shall provide high priority for mission-critical (safety-critical) communications.

6.4.7 Interface with Network Time System (NTS)

6.4.7.1 The Interlocking system shall have redundant interface with the NTS for accurate current time synchronization.

6.4.8 Interface with Enterprise Asset Management System (EAMS)

6.4.8.1 The Interlocking System shall provide static Asset Information and dynamic Asset Information to the EAMS for maintenance activities and asset lifecycle management activities.

6.4.9 Interface with Low Voltage Power System

6.4.9.1 The interlocking equipment shall interface with the Low Voltage Power Distribution.

6.4.9.2 Power supply parameters of object controllers and wayside objects shall be derived from the proposed interlocking architecture and confirmed by design. Limitations of power supply parameters shall be introduced to minimize the risk of electrocution as per safety analysis of subsystems.

6.4.9.3 It shall be ensured that access by personnel to exposed live wires from the power supply of the Interlocking system is eliminated.

6.4.9.4 The power supply of CBI, OCs and wayside objects shall be galvanically isolated from each other to avoid interference.

6.4.9.5 The TSCC Contractor shall ensure compatibility with the power supply required to power all actuators and auxiliary sub-systems of turnouts.

6.4.9.6 The TSCC Contractor shall ensure compatibility with all subsystems with the Uninterrupted Power Supply system.

7 MATERIALS, PRODUCT AND COMPONENTS REQUIREMENTS

7.1 General Requirements

7.1.1 All materials supplied by the TSCC Contractor shall conform to the requirements and test methods of the relevant EN standards or other applicable recognized standards.

7.1.2 All materials supplied shall be new and have sufficient grade and quality to meet the designed life requirements.

7.2 SW&HW Requirements

7.2.1 The CBI equipment is primarily railway specific equipment. The use of general commercial off-the-shelf (COTS) equipment as components, line replaceable units (LRUs) and modules to form CBI equipment or its support tools is accepted.

7.2.2 Design shall use standard materials and equipment, unless otherwise approved.

7.2.3 Equipment and materials shall meet industry standards, be available off the shelf unless otherwise approved, and supplied by established manufacturers.

7.2.4 Selection of equipment and materials shall consider:

- Long-term costs;
- Ease of construction;
- Maintenance;
- Readily available technical support.

7.2.5 The use of COTS equipment shall not prevent the CBI equipment or installations from meeting the overall requirements defined in this requirement document when it is applied as part of an integrated railway interlocking.

7.2.6 The Interlocking system shall be based on an existing approved product and must hold an approval certificate from one of the EU countries. Exceptions may apply to the EULYNX interfaces and are subject to Authority approval.

7.2.7 The certification of the CBI equipment used for the interlocking system shall include the following:

- Declaration of conformity for regulatory compliance by the manufacturer;
- Quality management system approval certificate covering design, manufacturing, and maintenance of the equipment;
- Evidence of conformity to the nominated standards produced by the manufacturer;
- Confirmation of the equipment being suitable for the purpose is supported by an ISA;
- CFR 236 requirements;
- A CHSR type approval for the application interlocking.

7.2.8 Conformity Assessment shall be compliant with standard EN ISO/IEC 17020.

7.2.9 The Interlocking system shall be structured into 3 layers in accordance with EN 50126/50716 and 50129 Standards:

- Generic product: Safety automated and associated tools that can support the generic application.
- Generic application: based on the CHSR operating and maintenance principles, the generic application corresponds to the functionalities of the system applicable to the entire railway line.

- Specific application: The configuration data for specific equipment and locations

7.2.10 The CBI shall manage the different main line stations as separate entities in such a way that:

- When data evolution is necessary for a station, the data of the other stations does not need to be modified or verified.
- The upload of the configuration of a specific station only requires the disabling of that station

7.2.11 Facilities shall be considered as separate entities in such a way that:

- When a track layout is modified within Facilities, the interlocking configuration data and logic related to the other Facilities does not need to be modified or verified, ensuring that the safety case of the other LFs is not affected.
- The upload of the configuration of specific Facilities only requires the disabling of those Facilities.

7.2.12 The architecture of the interlocking system shall allow the functioning of the system independently of the distance between CBI and OC, and between each OC.

7.2.13 The replacement of a failed OC or OC component shall not require shutting down the CBI while replacing the failed OC or OC component.

7.2.14 The replacement of a failed CBI, OC, or wayside asset shall not necessitate any software or hardware modifications of the equipment it is connected to.

7.2.15 Telecommunication parameters such as IP addresses shall be modified through a specific process which is separated from the data configuration process.

7.2.16 The OC shall be compatible with any future upgrade of wayside equipment requiring only minor software adaptation.

7.3 Associated Computer Tools

7.3.1 A set of test and commissioning tools shall be supplied. Among their functionalities, the following shall be implemented:

- The monitoring of the OC from any access point on the network: track movable elements (switch machines, derailers), displaying individual signal aspects, reinitializing axle counters once the authorization is granted by TMS.
- The simulation of any interface of the CBI such as OC, TMS and adjacent CBI.
- The testing of the CBI application logic

7.3.2 All tools provided by the TSCC Contractor shall operate on standard COTS computers using a standard Operating System (OS) to be validated by the Authority.

7.3.3 During the maintenance contract period, all IT tools provided to the Authority shall be supported by a commonly used OS, if the OS becomes unsupported. In case of a future OS update, the IT tools shall be updated accordingly to remain fully functional and shall not require any CBI interruption.

7.3.4 A set of tools allowing the delivery of control tables and the configuration of the data, its verification and validation shall be supplied.

7.3.5 The configuration data tools shall have a graphical interface reproducing the track layout.

7.4 Obsolescence

7.4.1 The TSCC Contractor shall guarantee the supply of any component (or an Authority approved alternative replacement component) of the CBI and Object controller, including the associated tools for a duration of 30 years from putting the system in operation.

7.4.2 The system conception shall be designed in such a way that the hardware obsolescence shall be managed without any impact on either the generic application or the specific application.

7.5 Interlocking Cable Requirements

7.5.1 CBI and OC cables shall be electromagnetic compatible considering the other cables and environment conditions.

7.5.2 All wires within a cable shall each have a unique visible identifier. The terminal each wire is connected to shall have corresponding visible identifiers.

7.5.3 The buried cables shall be protected against attacks by rodents and other animals.

7.5.4 All cables shall have protection for water immersion.

7.6 Cableway Requirements for Interlocking Cables

7.6.1 The TSCC Contractor shall assess if available capacity of cableways, manholes, ducts, and cable channels is sufficient for interlocking cables. In case if the capacity is not sufficient, the TSCC Contractor shall implement complementary cableways.

8 TOLERANCES

Not applicable to Interlocking System.

9 SCOPE OF SUPPLY AND DELIVERY

9.1 General Requirements

9.1.1 General requirements related to the TSCC Contractor Scope of Work are defined in Scope of Work.

9.2 Specific Requirements

9.2.1 The interlocking system scope of supply and delivery shall include (not limited to):

- CBIs;
- Object Controllers and axle counter evaluators;
- Maintenance and Diagnostic Terminal (MDT);
- Wayside assets (signals, switch machines, axle counters, staff protection system, derailers, etc.);
- Displays /HMIs;
- Cabling and connectors;
- Racks;
- Software architecture including full definition of protocols used;
- SW licenses;
- Maintenance and testing tools;
- Auxiliary elements and gear (cases, bird repellent spikes, attachments, bindings, testing equipment, etc.);
- Spare parts.

10 MANUFACTURING

10.1 General Requirements

10.1.1 General manufacturing requirements are defined in the Scope of Work.

11 INSTALLATION AND INTEGRATION

11.1 General Requirements

11.1.1 General installation and integration requirements are defined in the Scope of Work and Schedule 3.

12 TESTING & ACCEPTANCE

12.1 General Requirements

12.1.1 General testing and acceptance requirements are defined in the scope of Work and Schedule 3.

12.2 Specific Requirements

12.2.1 The TSCC Contractor shall be responsible for the V&V of the interlocking system requirements and associated interfaces requirements described in this technical specification.

12.2.2 V&V activities include (not limited to):

- Generic Product V&V;
- Generic Application V&V;
- Specific Application V&V;
- Tools V&V.

12.2.3 The TSCC Contractor shall develop a simulation environment to conduct as much testing on the equipment as possible before the on-site testing phase. The main goals are as follows:

- Test CHSR Signaling Principles within the CBI;
- Integrate CBI with TMS, adjacent CBI, OC, RBC;
- Test of the EULYNX interfaces;
- Test operational scenarios.

12.2.4 The CBI simulation environment(s) shall confirm that the CHSR Signaling Principles are fully implemented on the prototypes, and this implementation complies with the expected behavior.

12.2.5 The TSCC Contractor shall propose and fulfil a set of functional and operational tests that comply with all the functionality of CHSR signaling principles. These tests scenario shall be accepted by the Authority.

12.2.6 The CBI simulation environment shall be used to conduct specific application data testing.

13 SUBMITTALS

13.1 General Requirements

13.1.1 The submittals required for the Interlocking system are defined in the Scope of Work.

14 QUALITY MANAGEMENT

14.1 General Requirements

14.1.1 General quality management requirements are defined in the Agreement and associated Schedules.

15 ADDITIONAL INFORMATION REQUESTED

15.1 General Requirements

15.1.1 In addition to the mandatory requirements outlined in this specification, the Authority reserves the right to request from the TSCC Contractor and related Suppliers, information pertaining to the performance of proposed or supplied elements under similar service conditions, with particular emphasis on railway management aspects which may influence Interlocking system reliability, availability and maintainability characteristics.

16 LOGISTICS

16.1 General Requirements

16.1.1 General logistics requirements are defined in the Agreement.