Electronic Interlocking

1.1 INTRODUCTION:

1.1.1 The Electronic Interlocking System shall be of Solid State type and Computer based.

1.1.2 The System shall provide all the Interlocking, Control and Indication functions as per approved Interlocking Plan, Selection Table and Panel Diagram of the Station.

1.1.3 The System shall be suitable for working on sections having 25 KV AC Traction.

1.1.4 The effect of Induced Voltage shall be taken into account, while designing the location and number of Electronic Units on a section. Wherever the Induced Voltage is likely to be more than the stipulated limit, Object Controllers or separate Interlocking Unit at Stations without Points and Crossings shall be provided to cover the entire section.

1.1.5 For large Stations, which can not be covered by one EI equipment, it shall be possible to connect more than one EI equipment, preferably through a OFC channel.

1.1.6 Necessary provision shall be made in the Hardware and Software for modular expansion of the System.

1.1.7 Electronic Interlocking System shall have User Friendly Graphic based Design Tool to generate Station specific Application Software to carry out future yard modifications.

1.1.8 The EI shall be an Entry-Exit System.

1.1.9 The System shall have capability to interface with Central ATS [CATC] Systems.

1.1.10 The System shall be provided in a dust protected Cabinet. If Force Cooling is required, the Cooling Fans shall operate on System Power Supply with over current protection arrangement. The failure of any one of the Fans shall give an Alarm to the Operator.

1.1.11 The equipment shall be so constructed as to prevent unauthorized access to the System.
1.1.12 The System shall work on 24/48/60/110 Volts DC Power Supply.

1.2 ELECTRONIC INTERLOCKING REQUIREMENTS:

1.2.1 The System shall meet the Interlocking Requirements as specified in RDSO Specification 'IRS: S36'.

1.2.2 The Interlocking shall support all the feasible Train movements in the Yard.

1.2.3 The Interlocking System shall ensure that:

   (i) Conflicting Routes can not be set.

   (ii) Points are only moved, when all the safety conditions are met.

   (iii) Signals only clear to a Proceed Aspect, when all the Safety conditions are fulfilled.

   (iv) The System is Fail-safe and Failures shall not provoke an unsafe situation. Under failure conditions, Signals shall display a Stop Aspect and Points shall not be moved and shall remain in their last operated position.

1.2.4 In Normal Operation, the Route shall be released by the Train movement, if the Route is not set in the Fleet/automatic Mode. However, it shall be possible for an Operator to release the Route with a specific Local / Remote Control, as per the requirements of Operations as also to meet the emergent situations.

1.2.5 The Interlocking System, on receipt of a Route Remote Control from the ATS (the Command either originated from the Central ATS (CATS) or the Local ATS), shall permit to:

   (i) Control and Lock the Points to the position required by the Route.

   (ii) Set up the Route.

   (iii) Lock the Sub-routes of the Route.

   (iv) Lock the Route.

   (vi) Authorise the Route.

   (vii) Set the Aspect of the Signal, at the origin of the Route, to 'PROCEED' Aspect.
1.2.6 Start-up of the Interlocking:

(i) When the Interlocking is powered ‘ON’ or following a Shutdown, the Internal Variables managed by the Electronic Interlocking shall be set at the most Restrictive Status. The Inputs shall be acquired but the Outputs shall not be powered. When the Start-up finishes, an Initialisation Phase shall follow the Start-up, wherein an internal Timer shall maintain the variables related to the safe conditions at the most restrictive status for 120 sec.

(ii) When this Timer times out, the variables shall be set at the permissive status, if all safety conditions are satisfied and also Routes, Route Locking sections and Overlaps shall be released, if all safety conditions for their release are available.

(iii) The Timer permits an automatic initialization of the Interlocking and the value of 120 sec. shall be kept for covering the risk when a Train approaches an origin Route Signal at the highest allowed Speed and the EI fails and soon after restarts.

1.2.7 Interfaces:

1.2.7.1 EI shall be capable of interfacing with:

(i) Els at adjoining Locations (If of same Make).

(ii) Control-cum-Indication Panel (CCIP) or Control Terminal with VDU Display.

(iii) Signals – Main Signal, Route Indicator, Shunt Signal and Buffer Stop Signal.

(iv) Track circuits.

(v) Points.

(vi) Key Transmitters.

(vii) Crank Handles,
viii) Level Crossing Gates,
ix) Any other Specified Signalling Gear.

1.2.7.2 Interfaces shall be built-in taking in to account the limits of circuit parallelism permissible in 25-KV AC Electrification in a Metro System.

1.2.7.3 The connectivity between the two EI's, when placed at different locations shall be through OFC and the EI & field equipments shall be through Signalling Cable.

1.3 SYSTEM ARCHITECHTURE:

1.3.1 The EI should be based on Fail-safe Microcomputer System with independent I/O Channel.

1.3.2 The EI shall have a Fault Tolerant equipment Design using Redundancies or other Design Features to ensure that a high level of Train service is maintained in the presence of a single point failure.

1.3.3 The system should be configured in a Fail-safe arrangement conforming to Safety Integrity Level '4' as defined in CENELEC Standard EN50129.

1.3.4 Any of the following Architecture shall be employed in the system:

(i) Two out of Three Hardware Architecture with Identical or Diverse Hardware and Common or Diverse Software.

(ii) Two sets of Two out of Two Hardware with Identical or Diverse Hardware and Common or Diverse Software. Failure of Hardware will facilitate automatic changeover in a Fail-Safe manner without affecting Train Operation.

(iii) Single Electronic Structure based on Reactive Fail Safety with Diverse Software. The System shall be duplicated with On-line and Hot Stand-by Configuration.

1.4 SYSTEM COMPOSITION:

1.4.1 The EI System shall consist of the following:

(i) Microprocessor based Interlocking equipment to read the Yard and Panel Inputs, process them in a Fail-safe manner as per the Selection Table and generate required Outputs. Cycle Time and Response Time of the Microprocessor, to read and process the
Input shall be fast enough to ensure Safety and avoid any apparent Delay.

(ii) Control-cum-Indication Panel (Domino type) with Panel Processor having Stand-by Processor and / or a Control Terminal with VDU Display consisting of a Colour VDU Monitor, a Keyboard & Mouse or Digitizer.

Control-cum-Indication Panel shall conform to requirements spelt out in RDSO's Specification 'IRS:S-36 and RDSO: SPN 192'. It shall be provided with Push Buttons / Control Switches for Individual Operation of Points, Route Setting, Clearing of Signals, Releasing of Crank Handle, Cancellation of Routes and other functions as covered by IRS:S-36/RDSO/SPN/ 192.

(iii) Suitable Interface to receive and process the information for continuously displaying the current position / status of various field equipments and Track circuits on the Control-cum-Indication Panel or the VDU Display based Control Terminal using different Colors / Symbols.

(iv) Maintainer's Terminal with Display, Keyboard, Printer and Event Logging facility for minimum 100,000 Events.

(v) Relay Rack along with required number of approved types of Relays or Object Controllers / Element Interface Modules (EIM).

The Object Controllers / Element Interface Modules (EIM) shall be such that they can operate / receive Status information from Outdoor Signalling equipment (Signals, Points & Track circuits etc.) without any modification / change in the design of Outdoor Signalling equipment. The Object Controllers / Element Interface Modules (EIM) shall be centralized in the Station Equipment Rooms.

1.4.2 Maintenance & Diagnostic Aids:

(i) Maintenance Terminal consisting of a reliable PC, a VDU Terminal shall be used for the following:

(a) Display of the current Status of the Yard.
(b) Storage of Events.
(c) Display of Recorded Events.
(d) Data Transfer to secondary storage.

(ii) Control Operation of Yard functions shall not be possible from the Maintenance Terminal.

(iii) Facility of Annunciation and Display of faulty Card / Module for easy Fault Diagnostic shall be provided on the System. Suitable Alarms shall be displayed for this purpose.

(iv) A Trouble-shooting Procedure shall be built into the System to indicate the step by step actions to be taken in case of failure of the equipment.

(v) The System shall log all Events, Commands, Functions etc which should be Date and Time stamped, for enabling complete analysis of Safe and proper functioning of the System.

1.4.3 Networking of Maintenance Terminals:

The Maintenance Terminals of all Interlockings shall be networked such that Interlocking data is also accessible through a Maintenance Terminal from a Central location in OCC.

1.5 RELIABILITY AND SAFETY REQUIREMENTS:

1.5.1 The System shall conform to the Reliability & Safety Standards of CENELEC EN50126, EN50128 & EN50129. The System shall, in totality, meet the Safety Integrity Level – 4 (SIL-4) of the relevant CENELEC Standards.

1.5.2 Hardware / Software redundancy shall be provided to ensure that any single fault does not lead to unsafe failure.

1.5.3 The System shall communicate with adjacent EIs, where necessary. Dual serial/Ethernet/ocf link in Hot Stand-by Mode shall be used for this purpose.

1.5.5 Components used shall be of Industrial Grade and should be commercially available.
1.5.6 Integrity of the final Vital Output of the System for control of the field equipment should be continuously Read-back and Checked to guard against inadvertent Operation of the equipment

1.5.7 Software Requirements:

Software used in EI System should have been developed in conformity with a Software Engineering Standard EN50126, EN50128, EN50159-1&2, & EN50129 issued by European Committee for Electro Technical Standardization (CENELEC) with special relevance to Safety Critical Applications.

1.5.8 Verification and Validation:

(i) The System shall be based on Proven and Reliable Design.

(ii) The System shall be validated to Safety Integrity Level ‘4’ (SIL-4) of the relevant CENELEC Standards.

1.6 ENVIRONMENTAL REQUIREMENTS:

1.6.1 All the equipments shall be suitable for the environmental conditions of Indian Railways.

1.6.2 The Indoor System shall preferably be designed and manufactured for working in a non air-conditioned environment and ambient Temperature range between -10°C to 70°C and relative humidity up to 95% at 40°C.