Spec. No. RDSO/2008/EL/SPEC/0068, Rev.'0', July' 2008

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GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

TECHNICAL SPECIFICATION

OF

DRIVER TRAINING SIMULATOR

FOR

12000 HP, 8 AXLE

IGBT BASED 3-PHASE DRIVE

ELECTRIC FREIGHT LOCOMOTIVE

Specification No. RDSO/2008/EL/SPEC/0068, Rev.'0', JuLY' 2008

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1.0 GENERAL:

1.1 This specification outlines the technical requirements of design, development, manufacture, testing, supply, delivery, commissioning and maintenance of Driver Training Simulator for 12000 HP, 8-Axle, IGBT based 3-phase drive freight electric locomotives to be procured vide RDSO 's Specification No. RDSO/2006/EL/SPEC/0044 (latest revision).

1.2 The specification has been prepared on the basis of COFMOW's specification No. COFMOW/IR/M-SIM-2007.

1.3 This specification should be read in conjuction with latest revision of RDSO 's Specification No. RDSO/2006/EL/SPEC/0044 .

2.0 PURPOSE AND CAPABILITY:

2.1 Purpose:

2.1.1 The Loco Driver training simulators are required on the Indian Railways to help in their endeavour for providing efficient and safe operation to meet the demands of expanding traffic. Traffic expansion will require shorter time intervals between trains and longer heavier trains which will significantly affect the level of skill required of drivers of electric locomotive .

2.1.2 Drivers must be aware of relatively complex static forces within the train and the dynamic forces encountered as transitions occur in the dynamic state due to terrain or power adjustments. The available train instrumentation does not however provide the driver with any feedback or display of these conditions. Only in-depth training in train dynamics with the appropriate training tools can develop the basic understanding required, or the driver to consistently operate such trains safely and in an energy efficient manner.

2.1.3 Safe driving and to maintain punctuality are main objective of drivers. Full motion base simulator will provide realistic training in controlling the train.

Indian Railways, therefore, propose to install full physical simulated driving cab for training of locomotive drivers and for analysis of the activities in allied areas, such as train dynamics and braking. This installation shall simulate the locomotives and various types of wagons . Presently, the train drivers on the Indian Railways are given theoretical training in technical schools and practical training on a locomotive hauling a train. The proposed facility will supplement the existing training of drivers for handling heavier freight trains at speeds up to 120 Km/h.

2.1.4 The simulators should use the most recent simulation hardware and software. The simulators shall use Computer Generated Images technology for the visual data base. The CGI visual databases shall be interchangeable between the different simulators.

2.1.5 The driver means the person driving the loco hauled train.

2.2 Objectives:

The objectives of the simulator training will be to achieve :

2.2.1 Uniformity in behavioural pattern of drivers all over Indian Railways.

2.2.2 Decrease equipment damage.

2.2.3 Increase efficiency through reduction in time delays.

2.2.4 Quick response time of the driver to potentially dangerous, unsafe situations, such as obstruction on the track, poorly configured train consists, defective signaling, etc.

2.2.5 The development of good driving practices including adherence to the general operating rules as enforced on Indian Railways.

2.2.6 Efficient capability on the part of the drivers in respect of heavy haul, to understand the various aspects of longitudinal train dynamics, forces, effect of train negotiating on undulated and curved sections of varying grades, application and releasing of brake cylinders, brake propagation and effect of remote locomotive consist.

2.2.7 Development of capability of drivers to trouble shoot various malfunctions in the locomotive equipments that they normally encounter during train operation. The malfunctions shall be simulated generally as per details given in Annexure-V of However, final list of malfunctions will be decided during design approval stage.

2.2.8 Lower electric energy consumption.

2.3 Capability:

2.3.1 These simulators shall be capable of simulating the following with maximum possible realism:

i) Full replication of electrical locomotive cab and its controls individually as specified in this Specification.

ii) Projection of realistic simulated picture of track and front view as seen from driver's seat in the cab.

iii) Display of rear view of the train on a screen.

iv) Re-production of sounds as heard by Driver during run at various speeds & loads.

v) Realistic simulation of movement of the locomotive.

2.3.2 It shall have the capability to enable performance of the trainee driver to be monitored and guided through the instructor's console and evaluate the trainee's performance. A single instructor will be able to control the progress of each trainee independently. After every session of training, instructor shall be able to generate a report on the performance of the trainee.

2.3.3 The loco simulators should be capable of simulating 6000 to12000 tonnes freight train haulage at speeds up to 120 Km/h with one or more than one loco operation. The train may be hauled with up to 3 locomotives working in wireless remote control mode (Locotrol).

For locos and loco consists located anywhere in the train except at the head, it should be assumed that they operate with a separate driver. The communication between the driver of the head loco and the driver of the banking loco will be by VHF voice system. The instructor will play the role of the driver of the banking loco. Instructor station shall have an interface for the operation of banking loco. It shall be possible to simulate full loss of control of the banking loco (dead loco).

2.3.4 Operation of trains with braking requirement and brake equipment as specified in latest revision of RDSO 's Specification No. RDSO/2006/EL/SPEC/0044 should be simulated.

2.3.4 Banking operation requires different driving technique than driving in front loco. Driving of banking loco should be simulated in the simulator.

2.3.5 System should be capable of generating CGI of track by providing input of track data and trackside installations through user-friendly interface.

3.0 SCOPE OF SUPPLY:

The scope of supply shall include design, developement, supply, installation, commissioning and validation of identified hardware, software and facilities in India at sites as decided by Indian Railways. The supplier will provide complete documentation for the system supplied and its maintenance along with spare parts catalogue for all sub-systems, software, facilities, training, courses etc.

Brief details for the scope of supply include the following:

3.1 Simulator Cab:

A full size Electric locomotive cab identical in shape, size, colour and equipment layout to the same design as supplied by supplier in accordance to RDSO 's Specification No. RDSO/2006/EL/SPEC/0044 (latest revision).

3.2 Design:

Design of system facility including training methodology, keeping in mind the training needs of Indian Railway drivers, drawing up of detailed specifications of hardware and software, and detailed layout of facilities (building, hostel etc.) requirements.

The successful supplier shall develop a design, based on the general outlines in this specification as well as sound engineering practices. The main design solutions relative to railway operation shall be explicitly spelt out in the offer. The design concerning following items will be finalised in consultation with Indian Railways & RDSO before implementation:

i. loco and train model,
ii. cab equipment layout,
iii. signalling system,
iv. simulated sounds,
v. information provided to the driver (both content and format),
vi. Simulated limited malfunctions,
vii. specific CGI alongwith railway-related CGI objects such as OHE, station, signalling etc.
viii. driver evaluation and scoring rules,
ix. instructor training and day to day routine maintenance training.

The details of the data required from Railways as input for the successful operation of the system shall be mentioned in the offer.

3.3 Computer Generated Images (CGI) : The supplier shall supply computer generated images of track and surrounding based on representative sections, selected by consignee having training potential, with lengths totalling to 600 Kms (2x300 Km of one section, UP and DOWN) for each simulator. This CGI should have maximum realism with the selected sections. Simulator shall also be loaded with specific CGI of other simulators after commissioning of all other simulators and computer shall have sufficient memory for this purpose. It should be possible to extend the length of CGI in future for any length of track.

3.4 Training: Training to Indian Railway managers, instructors, maintenance technician and software engineers shall be provided to enable them to impart training to Indian Railways' locomotive drivers as per details given in clause no. 8.

3.5 Concomitant accessories:

The system shall be supplied alongwith following concomitant accessories and devices :

3.5.1 UPS: On line Uninterrupted power supply systems of sinusoidal waveform with 100% redundancy, separately for computer and motion system shall be supplied with the

simulator. The circuitry shall have necessary provision for automatic switchover on UPS in case of power failure. Both the UPS (for computer and motion system) shall have battery back up of atleast 30 minutes. During this time suitable warning shall be provided to the user that the power has failed and permit for shut down of the system in an orderly manner. The UPS shall protect the computer programmes and memory devices from damage and loss of data in the event of a sudden loss of power supply.

3.5.2 100 KVA D.G.set with automatic switching ON on power supply failure and OFF on resumption shall be provided.

Note: Power outages and fluctuations are common in India and the contractor will responsible for providing an uninterrupted filtered steady power supply to the simulator.

3.5.3 Simulator Building & Hostel:

The entire simulator system will be housed in a building of suitable design . The supplier will design and construct the required building on turn key basis. The building will be designed as given in Annexure V(A).

The supplier shall also be required to design and construct the 25 bedded hostel building meeting local byelaw of the location. The scope of the building will be construction, internal electrical wiring, internal water supply, furniture, central air-cooling, provision of UPS of minimum six KVA for emergency load of the rooms etc. The supplier will design and construct the required building on turn key basis. The building will be designed as given in Annexure V(B). The supplier shall be required to furnish drawings and specifications for the facilities of the building. The drawings and specifications shall be complete in all respects, including requirement of electrical, air-cooling and plumbing systems taking into account local site conditions, rules & regulations for buildings, safety, etc.

4.0 ESSENTIAL FEATURES OF THE SIMULATOR:

The specifications stipulate the requirements related to the design, construction, installation, testing and operation of the simulator. The simulator shall generally conform to this Specification.

4.1 LOCOMOTIVE CAB:

4.1.1 The simulator for use by Indian Railways shall consist of full size fully equipped electric locomotive cab and supporting sub-systems for the simulation of visual, motion and acoustical cues associated with train operations. The simulator shall be used for training and evaluation of drivers and to support advanced training techniques etc. The installation shall be at nominated stations decided by Indian Railways which is normally driver training schools and shall be operable by the trainers after suitable training by supplier.

4.1.2 Full size cabs of locomotives as specified in this Specification shall be provided by the supplier. It is the responsibility of the supplier to recondition and/or modify the components for applicable use with the simulator. The equipment layout shall be as close as possible to the reference locomotiwe cab and the layout drawings shall be submitted for approval by Indian Railways. The internal dimensions of the cab will match those of the reference cab with a tolerance of max. $\pm$ 2.5%. Additional instrumentation and components as supplied by supplier shall also be installed and resemble to actual class of cab equipment installation where applicable.

The cab compartment frame and panelling shall primarily be of steel. However, aluminium may be substituted for steel where applicable to reduce weight. Cab equipments and driver seat should be removable so that they can be removed for replacement/repairs. Cab interior and exterior shall be painted with enamel paint as per colour scheme approved by the Indian Railways. Finish of the interior should be choosen so as to avoid reflection of light to trainee loo driver.

4.1.3 Cab equipment:

4.1.3.1 The cab equipments in the cab compartment will be provided by supplier as per reqirement. One set of spare components shall also be delivered to the consignee along with main equipment for maintenance purpose.

4.1.3.2 The supplier shall supply the cab sub-system with the required support equipment which will include interface equipment that connects all cab controls and indicators to the computer

4.1.3.3 The equipment selected for modelling shall be chosen in such a way that the driver can perform train-handling operations under both normal and abnormal working conditions. Malfunctions can be introduced to force the driver to detect the dynamic effects of a malfunction and to overcome the effects of the malfunction through proper use of train handling procedures. Details of malfunctions are given in ANNEXURE-III. The equipments which are not physically present inside the reference cab but are necessary for training in train operations or for important troubleshooting operations, will be represented on a virtual touch-screen inside the driver's cab, based on animated photos and operable by the driver.

4.2 Instructor - trainee driver intercommunication:

The cab shall include a suitable loudspeaker and microphone for providing inter-communication between trainee driver & instructor. This shall enable the instructor to simulate the role of another member of the crew, or other railway staff who normally have contact in a train. The cabin will include a microphone with the output at the instructor's console, to enable constant monitoring of all audio signals audible inside the cab. These systems should be provided in such a way that the realistic view of the cab equipments is not disturbed.

4.2.1 In-cab CCTV:

A close circuit TV (video PAL) camera to view the cab interior and driver with video interface to a remote control room shall be provided. It will be connected to a colour display LCD TFT monitor of 19 inches or more on the instructor's console. This is to enable monitoring of trainee's reactions from a remote position. The video will be recorded on a computer hard disk during the training session. Replay of the video synchronised with the replay of a portion or of the complete training session shall be possible. A provision shall be made for storage of the recorded videos even after terminating the training session.

4.2.2 Lighting: The internal lighting as well as its intensity inside the cab shall be variable from near night conditions to near day conditions with control from instructor's console. Lighting level inside cab shall not be less than 300 lux to facilitate easy reading and provision shall be available for switching off the lights for visibility of signals during night.

4.2.3 Driver's auxiliary display (DAD):

A high resolution colour graphics, LCD TFT monitor of 17" or more removable from the mounting fixture shall be located near the driver's seat for display of track parameters (kilometre & hectometre marks, gradients, curvatures, position of switches and station platforms, over a distance of at least 2 km ahead of the train head etc.), forces, speeds, brake information etc. intended for use by the driver during training.

In addition to the above, the Driver's Auxiliary Display will be used for the display of graphs of relevant variables and parameters of the train as mentioned in clause no. 4.6.1.1

Operating instructions for gradient sections are different than those for level or flat sections. Therefore, coupler forces along the train shall also be continuously indicated in the cab so as to train the driver for safe operation i.e. without train parting.

The instructor and driver shall have the ability to select the data to be displayed through mouse control/user friendly touch buttons. Instructor will also have facility to disable the display of information on the driver's auxiliary display.

All units of variables and parameters displayed on the Driver's Auxiliary Display and all terms/terminology used should be as per Indian Railways standard terminology.

The ergonomics of the Driver's Auxiliary Display should be such to display with clarity and in different colours the curves and values.

The Driver's Auxiliary Display shall also be used for the communication and indication of all right signals exchanged by the driver, and for the display of the simulation status (run/freeze) for the information of the driver. The simulation of All Right Signal exchange shall also be done using hand flag with hard wire system.

Fault diagnostic feature of locomotive should also be simulated, that includes displaying of fault message on Driver Display System (DDS) available on actual locomotive.

This can be achieved by either providing message displaying on DAD in simulator or providing dedicated LCD screen of 15" or more in simulated cab. Later will be preferred.

4.3 Visual system:

4.3.1 The visual system will react naturally to all actions of the driver and of the train at all speeds in forward and reverse direction (traction, braking, train parting, loss of traction, etc.)

The simulator shall achieve a high degree of realism in visual display corresponding to the real time 3D computer generated images, and in a cost-effective manner.

4.3.2 Computer image generation & projection system should be capable of providing the driver with forward view of the scene ahead of the locomotive and a simulated scene of sky, earth & background that moves in correspondence to train speed and enhances peripheral vision/sense of motion. Image quality shall also be based on absence of stroboscopic effect on ties and software provided should totally avoid such effect.

4.3.3 Visual system shall be of high operating versatility and computer generated image configuration combined with a projection system facilitate image generation in variable environment conditions e.g. day light, night-time, foggy weather, rainy weather, etc. Image generating system should represent scenes from which it should be possible to achieve animation of signals, display of crowd on the platform with variable density and trains passing in the opposite direction. Position of switches and points shall be visible on the images, switching on the lights on the edge of the platforms as the train enters the station and animation of other mobiles (cars, motorbike, pedestrians, trucks, cycles etc.) as far as necessary for effective training.

The stations along the railway lines shall be so near realistic in the database that they are clearly recognisable by their geometry, colour, furnishing and inscriptions.

The following objects shall be covered in the visual representation in the CGI:

i. Open/covered station platforms

ii. Railroad bedding, including safety area below edge of platform

iii. Platform edge with safety strip

iv. 6 parallel tracks, or more.

v. Railway buildings and station cabins

vi. Furnishing of platforms (seats, showcases)

vii. Sign plates (e.g. station name, stops, name plates, platform numbers, destination display possibly in languages other than English also)

viii. Caution board, Speed restriction board, Panto raise/lower board, Neutral section board, EMU, TP/TG/Termination board.

ix. Entrances/exits

x. Overhead cross over bridges

xi. Kilometres posts, hectometre posts (where applicable) and gradient stones

xii. Railway signals, signs and boards, in compliance with General/subsidiary Rules of Indian Railways

xiii. Switch machines

xiv. People (Crowd on the platform)

xv. The surroundings should include river, hills, ravines, mountain, trees etc. along the track.

xvi. OHE on electrified lines:

a) OHE masts (atleast 3 types) with mast numbers

b) Neutral sections with auto-tensioning devices

c) Mid-section isolators

d) Isolators at switches and crossovers

e) Power supply substations/switching stations

xvii Models of people on the track and moving on platforms

xviii Presence of Railway staff working on the track

xix. **Lighting condition:** a certain amount of ambient light is available also by night . The facility of switch off the station light in case of run through train shall be available. Only security/ safety lights shall be ON like S.M's room, name board light of station, FOB etc.

In the surroundings of the railway lines to be represented, the environment is modelled in such a manner as to make the character of the line recognisable. Typical buildings are implanted along the track and the visual cue of the track (bridges, tunnels, Traction sub-station, Switching posts, underpasses, embankments, noise protection) are shown in a near-realistic manner.

While simulating night driving, the visual system shall be designed in such a manner that mast nos., cantilever & OHE should be visible.

In headlight turn on condition, head light beam shall be focused on track rather than lighting out side surroundings.

There shall be provision of simulating marker light of locomotive such that when it is ON, it will provided visibility to kilometre markings and other markings on track upto a distance of ten meters from front of Loco cab.

4.3.4 Following track and railroad objects will be animated in the visual system:

i. Turnout (position clearly visible on image)

ii. Derail switches

iii. Level crossings of different types with people and vehicles standing at closed level crossings and moving if level crossing is open

iv. Speed signs

v. Protection boards

vi. Whistle boards

vii. Indian railway signalling system including automatic signalling as per requirement of nominated sections

viii. Obstruction on track & track defects

ix. Obstruction to signal due to over growth of trees, bushes etc.

x. Standing train/EMU-MEMU or individual wagon / any vehicle

xi. Obstruction on the track by derailed train (passenger/freight train of max. 4 coaches/ wagons)

xii. Obstructions debries

xiii. Animals on or alongside the track

xiv. Passing trains/EMU-MEMU/DEMUs with headlights on and dimmed in night conditions in front view, and with last vehicle board during day or red lamp during night in rear view. The configuration of Passing trains/EMU-MEMUs should be same as working on Indian Railways.

xv. Obstruction in overhead contact wire such as contact wire broken, insulator of

OHE broken leading to panto entanglement

xvi. **All right signals:** animation of stationmaster, point man and gate man, manageable by instructor.

xvii. Standing trains with flasher light in "ON" position on same line or adjacent line.

Visibility of signals shall be up to 1.6 km depending upon the field of view. For all other items, the guaranteed visibility will be 50 m. If the realistic size of the object represented on CGI does not permit such visibility, the size of the object may be marginally increased to fulfil the training purpose.

4.3.5 Projection system shall offer the best quality of image. supplier shall provide a system with reduced overall dimensions while still guaranteeing sufficiently large projection surface area of approximately 4 m^2 to 4.6 m^2, maintaining the aspect ratio corresponding to the required CGI resolution as per the sizes of the looking glass window of the locomotive.

The projected image shall provide sufficient brightness and resolution to be easily viewable by the driver. Light output shall be at least 1500 ANSI lumen. Projector shall use modern LCD or DLP technology.

CGI shall be projected on a screen at a distance of minimum of 2.5 meters from the driver's eye. The angular size of the image, in any case, shall not be less than 60 degrees in width and 36 degrees in height, unless it is restricted by the physical size of the cab window. In case, the angle of view is limited by the physical size of the cab window, the supplier shall offer projection system suitable for the same.

The visual system shall be capable to represent the train motion at any speed in forward or reverse directions continuously and smoothly.

The supplier shall demonstrate that the field-of-view selected, and the projection equipment proposed provide an image with sufficient resolution and brightness.

4.3.6 The CGI image generating system shall meet the minimum parameters of image quality as mentioned in ANNEXURE-I.

4.3.7 The system offered shall provide for a single training session duration of at least two hours.

4.3.8 In order to attain these levels of performance for all the scenes, the details of' computer configuration shall be furnished by supplier as mentioned in ANNEXURE-IV.

4.3.9 Data base generation:

The supplier shall indicate the details and type of data required to be furnished by the purchaser for generation of the database. .

On the basis of these data, the supplier shall generate the data base of visual objects to be used in the CGI. The object library shall contain a sufficient number of specific and generic objects as per the requirements in order to generate visual scenes in CGI with required realism.

4.4 Sound System:

4.4.1 The sound system shall consist of digital sound synthesiser modules, stereo power amplifier, remote chassis mounting with control directly from the instructor's console and instructor's separate dual speaker chassis complete with quadraphonic sound system. The system design shall be capable of producing realistic sound cues characteristics of the Indian Railways operating environment for a selection of train and/or train related components detailed in as mentioned in ANNEXURE-II.

4.4.2 Sounds shall be reproduced in a quadraphonic way with displacement front/back, right/left. It shall represent the real time Doppler effect that shall provide realistic sensation, particularly when there is another passing train with or without horn.

It is required that the system allows the reproduction of at least 30 different sounds simultaneously with various intensities, tones, height and position in space. Communication messages shall be added without any alteration of the previous polyphony.

The sounds shall be synchronised with the motion of the train, actions of the driver and events being simulated.

The software shall control the amplitude of the sound level.

4.5 Motion System:

A motion system shall be designed to provide realistic movements of the cab, thus enhancing the drivers perception of operation in a real environment. The features of motion system are:

6 DOF cab motion system with electromechanical actuator technology shall be provided to achieve the effects, which are indicated below :

- Sustained longitudinal and lateral acceleration and deceleration, individually and in combination,
- Longitudinal and lateral jerk, individually and in combination,
- Vertical and lateral vibrations due to track joints and loco suspension,
- Sway to represent lateral impacts on entering the bends or on switching points Centrifugal force/cant resultant in the bends.

The performance of the motion system shall be furnished as per ANNEXURE-IV.

4.5.1 Motion cab control:

The motion cab control shall be provided to co-ordinate all input and output operations between the host computer system software and the respective hardware interface for motion platform, cab compartment and operators console. Software shall include provisions for all safety management, data formatting and unit conversion.

4.5.2 Locomotive ride generator:

4.5.2.1 Control software shall include a locomotive ride generator programme capable of providing inputs to the motion platform directing movement in the lateral, vertical, roll,

longitudinal axes. The inputs shall be computed from software models representative of driver cab as mentioned in this Specification, consideration of the track under the lead locomotive cab, velocity of the train and the feedback from the motion platform.

4.5.2.2 In addition, the same software shall support the following functions of the locomotive driver cab in operating environment:

i) A software model representation of the lateral and vertical suspension system for the driving cab to represent the response characteristic of a spring mass damper system/air suspension system interacting with actual track geometry.

ii) Software model computation for the bounce and rock associated with operation over jointed rail.

iii) Software model computation for lateral motions due to the motion of locomotive trucks within the gauge clearance on tangent track and in track curves.

iv) Software model computation for vertical motions related to discrete track continuity at switch frogs, grade crossings, and bridges.

v) Software model computations for accelerations of the cab due to slack run-in and run-out.

vi) Software model computations of jerks related to cutting off the traction motors during the transition from series to parallel connection of the traction motors (wherever applicable).

4.5.2.3 The motion system shall be able to represent the train derailment condition. The derailment shall be simulated by a considerable increase of oscillations of the motion system for a period of a few seconds. After that the simulation will freeze. The derailment event will be selected by the instructor.

4.5.3 Motion Platform Handler:

Motion cab control software shall compute the positioning commands for the motion platform using data from the driver cab ride generator software with relevant changes contributed due to the vertical, lateral, and longitudinal forces acting on the locomotive driver cab, and the motion platform position feedback. Provisions for subliminal acceleration shall also be included as part of the software design in accordance with physical travel capabilities and relevant safety constraints to be employed.

In addition, the software will perform all the transformations for converting the internally generated inputs into meaningful positioning commands with appropriate feedback mechanism validating the operating performance and safety of the motion base.

4.5.4 Interface:

The motion cab control software is responsible for the transfer of data to and from computer interface including the conversion of all internal data formats to the respective computer interface formats. An interactive calibration routine shall be part of the software design that allows for proper calibration of instrumentation attached to computer interface equipment.

4.5.5 Actuators:

The motion system shall consist of linear electromechanical actuators of reputed make and shall be highly reliable. The description and make of the servo motors and ball bearing screws shall be furnished in the offer. The actuators shall be equipped with limit switches that stop movement of the system if any of the actuator moves beyond pre-defined limits. A passive device shall also be provided at both ends of the actuator before the mechanical end stops reaches there. Moreover, provision for emergency braking shall be provided which stops the motion of the actuators in case of any failure.

4.6 Instructor's Console Desk:

4.6.1 The Instructor's console desk will be equipped with minimum 5 nos. of 19" TFT or better screen for display of the following functions:

a. **TPD:** Train performance display,

b. Cab replicate panel

c. Instructor's control

d. CGI,

e. CCTV in cab camera display

The instructor's console shall be provided to support remote monitoring and control functions associated with instructor/ trainee interactive training activity or evaluation exercise. Further more, the instructor shall be capable of total control for all factors relating to the train or simulator performance through direct interactive communication with the host computer. The design shall accommodate a central instructor station with modular console equipment. Controls and monitoring instrumentation shall be mounted in such a way so as to allow for operator ease in viewing and usage. The console shall have graphical, visual, user-friendly interface so that the instructor can access the functions via graphic images. The display monitors shall be mounted in a vertical structure containing two or more rows of monitors to facilitate the ease of viewing and control of the instructor station.

It shall be provided with a mimic diagram of the desk in the cab animated in real time on monitors, to enable the instructor and other trainees to easily follow trainee actions.

Along the same lines, it is proposed to have, for the instructors' benefit, the possibility to follow the train on a mimic diagram showing the track, the signals and their status, the future malfunctions/abnormal working. The instructor consol monitors will have the functions as describe below:-

4.6.1.1 Train performance display (TPD):

This monitor will display all the functions available in the DAD for the use of driver as described in clause no. 4.2.3.

4.6.1.2 Locomotive Driver Cab Status Monitoring (Cab Replicate Panel):

Instructor console locomotive status panel shall be provided for displaying sub-system controls, cab circuit breakers, air brake and engine control panel functional status. Instructor control status shall be provided on one or more monitor for monitoring locomotive controls and indicators as found on the cab control stand and forward cab bulkhead. The cab replicate panel shall present animated pictures of all the in-cab equipment which is in the scope of simulation and the position or status of which may change in the course of a training exercise (train driving, malfunctions, events, AWS etc.)

The representation of the equipment on the screen shall be in groups of equipment with related functions and controls. Two or more monitors shall be used for this if necessary, in order to avoid image swapping on a single monitor. For locos with microprocessor control having in-cab screens displaying messages, the display of these messages shall be integrated in the cab replicate panel.

4.6.1.3 Instructor Control Interface:

The Instructor will have a dedicated interface to start, run, freeze and stop the training session, select trains, tracks, section and scenarios, follow important train and track indicators and events, set-up routes, malfunctions, select passing trains etc. The

Instructor shall have the possibility to follow the train on a mimic diagram showing the track, the signals and their states, modify the line speed limits etc. The mimic diagram shall be a 2-D top view of the tracks showing switching points, stations, platforms, level crossings. Design shall include use of mimic diagrams subdivided by related functions and controls. The Instructor shall also have the possibility to modify hauling power, brake power, adhesion, rate of BP and MR leakage as well as select train composition with different loads of wagons, varying from 0 to 125% of the nominal value.

The instructor will be able to accelerate the time of pressure build-up in the brake system to increase the efficiency of the training.

It shall be possible to store on the system hard disk a complete training session (without the CCTV recording) in order to be able to replay the scenario even after the end of the current training session.

4.6.1.4 CGI monitor:

This will display the CGI as seen by the driver on projector screen in cab.

4.6.1.5 CCTV in cab camera display:

This will be connected to in cab camera installed in the cab and display will be done in real time (refer to clause no. 4.2.1)

4.6.2 Instructor communication and motion system control console:

The instructor will also have a dedicated communication and control console for audio communication with the driver and for the release/reset of the motion system safety loop (see clause 4.6.3).

While the instructor shall be able to hear continuously all the sounds and driver's voice in the cab, he will talk to the driver through a push-to-talk system. He shall be able to set the audio level of the sound at the instructor station.

The instructor and driver shall also be equipped with walkie-talkies to simulate communication between driver and driver of banking loco / station staff / guard etc.

4.6.3 Motion System Emergency Control:

Emergency control switches, specifically designed for emergency stopping and lowering of the motion platform in the event of operation becoming a hazard to man or machine shall be provided in the cab, instructor's station and simulator room etc. The number and location of the emergency switches should be indicated in the offer.

4.6.4 UPS status display:

There should be display of UPS status on instructor control desk. This should have at least following information:

a) UPS on battery.
b) UPS on normal AC supply
c) Battery low

4.6.5 The following main functions shall be made available to the instructor:

i) Preparation of scenarios, prior to training sessions: A scenario describes the simulation conditions (type of locomotive, rake length/formation, unit formation, train length, atmospheric conditions, itinerary) together with the events due to occur (anomalies on the train or signalling, obstacles on the track, opposing trains, OHE wire hanging, abnormal working situations etc.). The instructor can then visualise the scenario in the accelerated mode to check its consistency. This is a genuine time saver for preparing scenarios and lets the instructor concentrate on training with the drivers present (answering trainees' questions. comments on drivers' behaviour during the training session).

ii) Addition or removal of anomalies (on the train, track or signalling) is possible either in scenario preparation mode or in real time during simulation, and several combinations and positions of faults should be possible.

iii) Changes in conditions for simulation, with no limit in time: time of the day, weather conditions (see clause 4.6.8).

iv) Taking of snapshots (simulator state at a specific moment) and possibility of returning to snapshots to resume simulation. For example after a trainee driving error, return to snapshot means simulation can be resumed at an earlier state to correct driving behaviour.

v) Replay mode in which all trainee actions on the switches and push buttons are stored during simulation and then replayed on the computer, thus enabling the instructor and driver to mutually visualise and comment on driving. This function is vital for detailed description of critical driving procedures, for example on starting a freight train.

vi) Simulation of train operation with banking loco: For trains with a loco in the rear of the train, the instructor shall have access to a simplified virtual interface to play the role of the driver of the banking loco (control of speed and brake), the simulator cab representing the head loco. The trainee driver will communicate with the instructor by a walkie-talkie system.

vii) Instructor station should be equipped with a separate off line scenario making workstation to facilitate preparation of scenario without interfering with the use of simulator for training. The hardware required for offline scenario work station will be provided, in addition to the hardware required for instructor console. supplier shall furnish the details of hardware for offline scenario workstation.

viii) There shall be provision of saving the scenario giving appropriate user customisable name into a separate file. It should be possible to save these files onto a hard disk or other popular external storage devices and to use it after any upgradation of existing software to a new software version.

4.6.6 Exercise control and library:

It shall be possible for the instructor to generate exercises and it shall include at least the following:

i) Selection of locomotive type (freight)

ii) Creation of train configuration:

a. Selection from list of locos, wagons: for all loco simulators, a set of different types of wagons shall be available for the creation of train configuration.

iii) Creation of freight loading in comparison of nominal load

iv) Choice of route/section

v) Location of equipment malfunctions

vi) Selection of abnormal working conditions

vii) Selection of scenario specific performance criteria

viii) Stored, prepared exercises

ix) Modify stored exercises

EXERCISE MONITORING:

4.6.7 Exercise Development Software:

The exercise Development Software (EDS) design shall provide the ability to create, modify, display and maintain an assortment of operational data files in specific libraries that include: train configuration, vehicle data, and displays each easily maintained off-line by the user via a screen editing feature using graphical user friendly interface. All data entries are to be validated as to form, size, application, and content. Parameters of some of the vehicles are given in ANNEXURE-I.

4.6.8 Train configuration and exercise creation facilities

The system shall include a user friendly facility for designing various train configurations. A train configuration shall include as a minimum the following entries:

(1) identification
(2) Locomotive specification
(3) brake line pressure
(4) maximum operating speed
(5) gross weight and position of each vehicle and type
(6) Regeneration braking conditions.

During the exercise the monitoring and controlling pages shall provide the instructor with the facilities to:

i. Select, run, freeze and resume an exercise
ii. monitor the status of all the cab equipment included in the simulation
iii. monitor the train position along the exercise route
iv. change the rail wheel adhesion value
v. change in brake power of the train and making brake power of individual wagon ineffective
vi. change in tractive power
vii. change the aspect of approaching signals (both colour, MAUQ and Lower Quadrant semaphore)
viii. change visibility and weather conditions
ix. Introduce events such as train faults and tripping of circuit breakers, alarm chain application, guards brake valve application and closing the brake pipe angle cock in any vehicle.
x. Introduction of Automatic Warning System/Train Protection Warning System etc. actuation
xi. Introduction of faults and abnormal working conditions
xii. introduce a train parting scenario
xiii. analyse stored results
xiv. replay stored exercises
xv. operate banking loco through a simplified virtual interface
xvi. Change in OHE Voltage with three possibilities : Normal, High, Low
xvii. Single line (wrong line) working
xviii. Working in automatic signalling territory
xix. Temporary Single Line Working

4.6.9 Additional monitors for other trainees (Observer station):

In addition to the instructor's console, a Observer station shall be provided with minimum 4 nos. of 41" plasma screens so that at least 6 additional trainees can observe the driver's actions, functional sequences, important operating data and malfunctions during an on-going exercise. The observer station shall also be provided with marker keys, which can be operated by the trainees to mark specific exercise events of interest, which can be retrieved and discussed after the completion of the exercise with the instructor.

Alternatively any other better system to cover all the trainees can be provided. The cost may be quoted separately. Method of view may also be explained.

4.6.10 Data Post Processing and Reporting Subsystem (DPPRS):

The DPPRS software is to provide for unique report generation at the end of or during the training session, to facilitate evaluation of trainee performance. Specific type of report to include:

(1) Performance scoring allows a single relevant numeric score to be generated for a run in addition to supporting information for post analysis. The supplier shall specify his approach to the design of a scoring system and provide substantiation of particulars through description of the results of existing scoring system designed by supplier and in current use.

(2) Trainee summary report of performance activity during the experiment with highlights of infractions.

(3) Experiment run summary display summary of experiment run of the selected time segments highlighting major variable recorded.

(4) Recording ability to record, save and archive the train run for correlation to other DPPRS reports.

Software shall provide terminal display and hard copy print outs for the following summary reports:

1) excess pre-defined limits of train handling and driving (speed, throttling, SPAD, etc.) The scoring rules to be implemented shall be proposed by the supplier and approved by Indian Railways before implementation
2) in-cab control manipulations
3) energy consumption, conservation (regenerated energy and coasting)
4) throttle/ master controller position and brake usage
5) speed and distance covered.
6) train configuration
7) all types of events which occurred during the training session
8) weather conditions
9) max buff force and draft force experienced on 10 different locations of the train
10) general information: trainee name along with his headquarter/ division/Railway, date, scenario etc.

The simulator shall contain a data base management system to store the training and scoring reports for individual trainees, with the possibilities to retrieve, compare, sort, delete, archive training results. The supplier shall describe in detail the proposed system and its functions.

4.6.11 Display Graphs:

Data acquisition and display software shall allow for real-time data graphs that may be generated for display to the train driver in the cab (on the Driver's Auxiliary Display), to the instructor in the control room or to both locations simultaneously. The software design shall be such that any variable computed by the modelling software may be included in either a digital or graphic display with an update rate of atleast one per second. The driver/instructor shall have the possibility to select the desired variables to be displayed from a specified list of variables. Graphs may be displayed and printed in colour, indicating the selected variable plotted as a function of time or as a function of distance (the distance scale shall correspond to the km posts of the selected track).

4.6.12 An exercise library containing 10 exercises, each of approx. 45 minutes to one hour duration shall be provided by the supplier. These exercises shall be prepared in consultation with representative of IR and will be capable of demonstrating the capability of simulation of goods trains fully. It will be possible for the instructor to modify these stored exercises also.

4.7 COMPUTER SYSTEM:

The supplier shall meet these minimum requirements of hardware and software as given in ANNEXURE-I.

4.7.1 Hardware and operating system:

The computer system shall include PC based operating system. The supplier shall offer the most recent PC hardware and running the most recent operating system release with adequate CPU and 3D graphics performance, guaranteeing smooth real-time performance of the simulator, easy maintenance and upgradeability. Adequate storage capacity shall be provided. A DVD burner shall be provided for back-up and archiving purposes. The operating system shall be capable of real time interrupt response & management of standard peripherals.

Special attention shall be paid to the 3D graphical cards, where the latest model of reputed manufacturer should be used to guarantee optimal performance of the real-time 3D visualisation software.

Supplier can offer enhanced hardware configuration giving details of advantages over the configuration as specified in ANNEXURE-I.

4.7.2 Software:

It should be able to simulate electric locomotives as specified in this Specification, various freight stock that are in use on the Indian Railways. For simulation of electric loco hauled trains, the parameters related to overhead equipment (OHE) on Indian Railways should be kept in mind.

The supplier would develop/modify the software to be used in the simulator to suit Indian conditions in association with Indian Railways. The software shall be such that it delivers the required output in user friendly measurable manner and this shall use high level language to avoid any tempering of the software.

User friendly software should be provided to incorporate following changes :

1. Traction-braking characteristics of locomotives as per design
2. Braking and dynamic behaviour of the rolling stock.
3. Parameters of a track section.

The Indian Railway personnel should gain thorough knowledge so as to become capable to configure the software to create different combinations of trains, modify main parameters of locos and wagons necessary to prepare realistic training scenarios covering the common real-life situations (variable traction and braking efficiency, dead loco, wagons with no brakes or with blocked wheels). It should be able to indicate suitable guidelines to the trainee drivers to indicate the safe train handling practices for operating particular trains on specified sections.

The train base data would be developed so that the user can make up specific train configuration from wagons and locomotives resident in the vehicle data base.

The wagons and locomotives can be placed in the desired location in the train and then loaded to the desired weight so that the simulator models of actual trains are operated in real life. It should be able to compute forces wagon by wagon for realistic simulation of train behaviour in order to teach/analyse train control procedure.

The system shall provide means to create an "ideal" run by an experienced driver using the simulation software. The software will have the capability to record and store the relevant reference values (acceleration and deceleration, brake application, etc.) to be used for comparison and evaluation of other drivers. In this way simulator shall enable to create a reference for safe driving practices, which may be used for guiding trainee drivers. The software should specify the regeneration of energy in electric locomotive.

The supplier should specify the technical parameters of the Indian Railways stock that are to be fed into the programme, co-ordinating with Indian Railways for collection of data and arrange their use in their programme.

4.7.3 Operating System:

The supplier supplied computer operating system shall be a modern PC-based operating system in its latest available version. The operating system shall have features like debugging aids, capable of real time interrupt response & standard peripherals.

4.7.4 Control Software:

Control Software shall be responsible for controlling the system operation and shall consist of a number of specialised software programs that accomplish the following tasks:

1. accesses the databases and co-ordinates the modes and communications within the system components.
2. operates the hardware interface to cab, operator terminal and motion base, along with performing all formatting and unit conversion.
3. performs modelling tasks using real-time modelling techniques and shall include a minimum of four basic models, namely locomotive, brake system, longitudinal and driver evaluation.
4. interface the input to the respective data base and co-ordinates output data transfer
5. allows communication with the operator in selecting the operating mode, exercise to be run, specifying initial operating conditions, and variation to the run program.

4.7.5 System Mode Control:

The control software shall provide a set of system operating modes selectable from the operator's console that are to include:

(1) Test
(2) Initiation
(3) Set-up
(4) Run
(5) Freeze
(6) Replay
(7) Restart

The control software shall also provide during these system operating modes, displays and where necessary, comments to the terminal operator necessary to start-up the system, initialise the experiment, control and monitor the experiment in progress, monitor the system health and complete the specific experiment.

4.7.6 Instructor's Console Control Software:

The control software shall support the following instrumentation control features

(1) provide display of cab controls and instrument status
(2) co-ordinate the subsystems processing relative to the specified operating modes
(3) interactive, control and monitor capability for the experiment in progress
(4) data input and display
(5) control, modification and co-ordination of additional locomotive controls.
(6) curves of braking efforts, power consumption, speed etc.

4.7.7 Experiment Replay:

Software to provide for the capability of graphical displays of specified experimental data from the date recorded since the beginning of simulation.

4.7.8 Test Requirements:

During system start-up, it shall be required that the software determine the operational status of the various subsystems and display the results at the instructor console.

4.7.9 System Start-up:

The host computer controller shall provide a system control executive that allows execution of a start-up routine locally by the operator. Typical sequence shall include the following tests :

i) Desk test
ii) Software test
iii) Hardware test
iv) Test of discrepancies between desk actuators and simulation state recorded in a snap shot.

The simulator shall be provided with a self checking diagnostic system to allow the instructor and maintenance personnel to check the operational integrity of all the subsystems. This self checking diagnostic system shall be operated as per the requirements of the instructor or any other authorised personnel. The system must display recommended remedial measures at 2 or 3 levels in the event of a failure. Suitable communication system shall also be provided from each simulator to the supplier's maintenance centre for rectifying faults in the software.

4.7.10 Inter-processor Communication:

The communication executive within the host computer controller shall co-ordinate I/O within the system per control of a dedicated software module for all system operating modes.

4.7.11 Cab Interface Requirements:

The control software shall support the locomotive simulation by providing the drive signals to the cab's instruments and controls. Also, the software is required to support the instructor by providing status of the cab's control and displays to the console .

4.7.12 Cab Motion Control:

The cab motion shall be provided to a motion platform under the direct control of the main computer software. The software shall provide the basic cab motion representative of a realistic ride and will be co-ordinated with other cue generating subsystems in a non-conflicting manner. Induced motions shall include : lateral, vertical, roll motions and acceleration changes. System safety must include a permanent self-diagnosis and return of messages to central computer.

4.7.13 Audio-visual Control Requirements:

The control software shall co-ordinate the visual and sound cues to the driver with support of its audio-visual control software. Responsibilities include the forward view projection system with projection of real time computer generated images including rear view in the simulator cab.

4.7.14 Sound System Control:

The control software shall be responsible for controlling the types of sound generated by the sound synthesisers, the duration and sound pattern with the support of the audio-visual control software.

4.7.15 Train Modelling Requirements:

Dynamic modelling should take into account:

i) Train composition.

ii) Curvature and gradient throughout train length.

iii) Driver's actions (Traction, Braking, Automatic warning system, Train protection warning system, Vigilance control device and Safety rules related actions)

iv) Track condition (slippery or dry rail or rough track patches)

v) A realistic environment so that the driver operates in the same manner as he would in the real train.

vi) A comprehensive data collection, display and reporting capability for an efficient and objective training experience, as described above.

Software provided shall be capable of simulating the performance of the train composed of electric locomotives with goods vehicles in use on Indian Railways. The simulation shall be such that the driver's action in the cab produces a corresponding response through out the train and the results of his actions are reflected back to him, appropriate readouts on the cab compartment gauges and instruments along with visual and sound cues. Real-time software modelling techniques shall be employed to accommodate the required simulations of train configurations with the locomotives and the corresponding brake retarding forces acting on the train.

The train modelling software shall allow the operator the option of selecting a train configuration among several pre-determined train configurations or building a train on a wagon-by-wagon basis, including the possibility of other locomotive consists placed anywhere within the train formation. In addition, the operator shall be allowed to specify particular physical characteristics for each wagon in the train model. The simulator shall support train length up to 150 bogie freight wagons. The track characteristics such as number of tracks, curvature, gradient and super elevation beneath the train shall also be simulated and correlated with a data base to specific experiment territories. The train simulation shall be capable of calculating the total forces acting on the entire train for determining resulting speeds and corresponding locations on the track.

The train modelling software shall also allow to specify typical malfunctions, which may occur during train operations and correlated to specific time/place occurrences.

4.7.15.1 Locomotive Model:

The locomotive model software shall be able to simulate the functions for up to 3 locomotives in a train. The software must accommodate modelling a lead consist of up-to two locomotives and a remote consist of up to two locomotives placed anywhere within the train. Control between leading consist and trailing consist will be with remote radio contol such as LOCOTROL.

The software shall be capable of calculating for real-time operation, the total tractive effort, dynamic braking effort, EP/regenerative/auto braking effort, power, and energy consumption for each locomotive within the train. In addition, the software must be capable of supplying the appropriate locomotive control action and malfunction responses and include the phenomenon of wheel-rail adhesion for detection of wheel slip.

4.7.15.2 Air/Electro pneumatic Brake Model:

The brake model software shall be able to simulate in real-time the performance of air, EP, Auto & Emergency brake system blended with/without regenerative brake system currently in common use on the Indian Railways. The design shall be based on use of a fluid dynamic model that is characteristics of the physical air flow and pressure distribution within the air brake pipes. Consideration shall be given to typical pipe pressure variations resulting from train, makeup, variable wagon length, and the number and position of valves and brake pipe leakage. The software design shall be capable of interpreting the brake valve control settings along with the prior air/EP brake operating state, and be able to calculate the resultant air flow and pressure distribution within brake and feed pipes. For accuracy the calculations must recognise the frictional effects present from the pipe surfaces and similar restrictions to the flow and account

for leakage conditions, at each wagon, handling maximum makeup of 150 wagons for goods train. This software model must accommodate the dynamic/regenerative braking interlock condition and emergency brake cut-off applications. The supplier must ensure the computation interaction rate and technique will produce good approximations for all braking modes. Brake model software shall demonstrate operation of a twin pipe and single pipe graduated release, air brake system type 28 LAV-1, EP brake system and meeting UIC 540 brake equipment specification. Primary features detail the locomotive brake valve operation, monitoring of' the main reservoir pressure and air flow through the brake and BP, FP & MR pipes.

The software shall also include operation at each of the wagons of the auxiliary reservoir with charging by the feed pipe check valve and the corresponding distributor valve action on the brake cylinder with the application and release of the brakes. Brake force shall be result of piston thrust directly related to the brake cylinder air pressure at each wagon transmitted through the rigging and magnified by mechanical leverage to the brake shoes. Particular attention must be given to rigging efficiency, net braking ratios and coefficient of friction of the shoes (Cast iron & composition type) for empty and loaded car conditions.

The supplier shall use generic tools for the development of all the numerical models simulating the physical behaviour of train circuits and automation systems. These tools must be fitted with a graphic interface designed to represent and configure circuits and automation diagrams.

4.7.15.3 Longitudinal Train Dynamic model:

Longitudinal Train dynamics model calculates the dynamic changes associated with variations in tractive effort of the locomotive, the initiation of braking forces, and changes in grade. The model software design for the heavy haul locomotives shall use discrete variables to characterise up to 150 individual wagons in the goods train makeup. The software shall be able to define the relevant instantaneous velocity, location and inter-wagon coupler forces contributed by the external forces existing on the individual wagons. These forces are primarily due to wind resistance, rolling resistance on tangent or curved track and the longitudinal forces that result on grades. The longitudinal train dynamics model is intended as software library used by the Runtime Software (RS) for correlation of the interaction between vehicles and determining the minimum force to closure between blocks of trains.

The software must reliably predict the real-time development of slack effects during train operation by considering the initiating shock motions and coupler impact forces under real-time operating conditions. The design shall recognise and define relevant longitudinal compressive and tensile forces being transmitted between the individual wagons and then establish the inter-wagon relative displacement condition. Equally important is the free-slack condition where no inter-wagon forces are being transmitted. Similarly, the software design must also model blocks of wagons and define related inter-wagon and cumulative forces for various train makeup.

4.7.15.4 Driver Evaluation Model:

The driver evaluation model software shall rely on input from other software programmes within the system that monitor the real-time status of particular train and operating terrain characteristics, along with the action of the train driver and the response of the train to these actions. The software shall be able to accommodate changes in the types of trains and their operating terrain during the operation of run-time software. Based on the source data input, the software shall be capable of determining the status of specified operating limits and reporting excess conditions. The software shall report the occurrence of specific driver control manipulations in accordance with an instructor designated software performance criteria.

4.7.15.5 Driver Evaluation Criteria:

Evaluation criteria shall include provisions for at least the following operating limits and performance assessment parameters. The report shall have conditions exceeding predefined limits and assessment parameters:

(1) Absolute limits:

(a) maximum/minimum coupler forces
(b) maximum reduction of brake pipe pressure
(c) electrical energy consumption
(d) Over speed and under speed limit
(e) Amperage
(f) coupler fatigue
(g) observance of AWS/TPWS message

(2) Performance assessment parameters for gradation of drivers:

(a) Driving techniques
(b) Knowledge of safety and operating rules
(c) Technical knowledge and trouble shooting

The details with respect to simulator requirements will be finalised during design phase in consultation with RDSO. The software shall have the means to pre-define evaluation criteria for judging driver performance at various trainee levels.

4.7.15.6 Control Manipulations:

Software shall include source data input for the following control manipulations and report designated conditions:

i) power braking, monitor application of brakes relative to brake control notch position, report operating status and excessive conditions.

ii) running release, monitor the time of brake release relative speed, report resultant slack action.

iii) cyclic braking, monitor the application and release of brakes relative to the recharging of reservoirs , report undesirable conditions.

iv) optimum speed profile, driver train handling techniques including negotiation of neutral sections, report status and deviations from an operator designated speed profile.

4.7.16 Documentation:

4.7.16.1 The supplier shall be required to submit to Indian Railways six copies of a detailed formal documentation package, written in English, which shall be subject to review and approval by Indian Railways prior to final acceptance. The documentation package shall be complete with contract drawings and clearly describe the system hardware and software design, system installation and operation, approved test plans with complete testing results, maintenance procedures and training course material. Equipment manufacturers technical and owner's manuals covering design, operation, maintenance and trouble shooting for all equipment supplied shall also be included wherever applicable. All documentation shall be supplied on hard copy as well soft copy on CD. Two sets of these documents will be supplied to RDSO.

4.7.16.2 Contract Drawings:

Contract drawings shall be a complete drawing package. Contents shall include the following drawing sets:-

Electrical wiring diagrams and schematics, mechanical layouts, interface diagrams, facilities layout & drawings and as built drawings covering equipment installation system operation, maintenance, testing for all equipment supplied and building & hostel design and detail engineering drawing layout.

4.7.16.3 Software Documentation:

Software documentation shall include system software design and reference manuals, system software operating manual, operating system utility programmes and interface control reference.

4.7.16.4 Validation of Software:

The supplier shall also validate the software and prove to Indian Railways beyond doubt that the software incorporates all the data obtained from Indian Railways for the track, locomotive, rolling stock and various other details.

5.0 OPTIONAL FEATURES:

5.1 Software for Ideal Run Analysis:

Based on train composition, maximum speed of the train and speed -restrictions, the software should be able to generate an ideal (theoretical) run with minimum specific energy consumption and optimum running time so that driver's' performance could be compared with this ideal simulated drive for objective evaluation. The software should specify the regeneration of energy for all types of train composition. The input to the software i.e train resistance/ braking or traction characteristics, gear ratio, weight of wagons/locomotives, functioning of EP brake etc. which are required by the supplier should be clearly spelt out and to be finalized during design approval.

It should be possible to run this software independently on separate PC for the development and incorporation of new design features like change in traction motor characteristics, gear ratio, speed restriction etc.

5.2 Any other accessory, which in the opinion of the supplier can contribute to better utilisation of the equipment and effectiveness of the training of drivers, shall be clearly indicated and quoted for separately.

6.0 ENVIRONMENTAL CONDITIONS AND POWER SUPPLY:

6.1 The supplier shall indicate the necessary energy efficient air-conditioning required in the facility housing the simulator. The environmental conditions prevailing in India in which simulator shall be required to operate satisfactorily under the conditions as specified in RDSO 's Specification No. RDSO/2006/EL/SPEC/0044 (latest revision).

6.2 The supplier shall indicate clearly any other environmental conditions for storage required to be maintained by the Indian Railways both for the driver's simulated cab, instructor's console areas and computer.

The normal and other power requirements for the proposed simulator shall be furnished. The quality of power supply required shall also be indicated in the offer.

7.0 INSPECTION & TESTING:

The supplier shall supply a specific quality assurance plan, with follow up by the supplier of the quality of all sub contractors to a standard and consistent with international

standards ISO 9001:2000 and be required to prepare and submit test plans for conducting subsystem level tests and system acceptance testing that verifies proper operation of all equipment and software included in the simulator. The test plans shall include a description of the Subsystem or system test levels employed, test objectives and a description of the methods for verifying acceptable operation of the hardware and software configuration. In addition, the test plans shall clearly describe the test sequence and procedures, test equipment; and data reporting format. The test plans are subject to the approval of the Indian Railways who shall reserve the right to witness all factory and on-site testing.

7.1 The sub-system level testing:

The subsystem level testing shall be performed on each major subsystem and include motion, visual, sound, computer hardware and software, cab and experiment operators terminal subsystem. Furthermore, the entire dynamic system shall be tested as a complete unit with train operation over various simulated terrain and the train dynamic features clearly demonstrated through use of run-ins and run-outs during power and brake application.

7.2 Factory Acceptance test:

Following installation at the supplier's facility, the contractor shall have the system fully operational and demonstrate complete operational compatibility of all subsystems as per the approved test plans. Tests involving subjective criteria for verification of performance, such as the simulated push button horn sound, must be defined as such in the test plan and performed to the satisfaction of a designated representative of Indian Railways.

The system acceptance test plan prepared by supplier shall include provisions for functional testing of sub-system and a complete, fully assembled, operational system for demonstration of complete hardware and software compatibility. The test plan shall be complete in description of all operating functions the hardware and software configuration. Test methods, test sequencing and testing procedures and demonstration of all computer modelling software. Supplier shall be responsible for demonstrating the acceptance test plan at the supplier's facility using the actual simulator subsystems for the purpose of review and approval of the test plan by Indian Railways prior to shipment and installation. Before factory acceptance test by inspecting authority of Indian Railway, the supplier shall submit internal test reports for the complete system and sub-systems of the simulator as per test plans to the inspecting authority of Indian Railway.

7.3 Installation and Commissioning:

The supplier is to be entirely responsible for the execution of' the supply strictly in accordance with the terms of this specification and the conditions of offer notwithstanding any approval which Railway Board or the Inspecting Officer may have given:

i) of the detailed drawings prepared by the Suppier.
ii) of his sub-suppliers materials.
iii) of other parts of the work involved by the supplier.
iv) of the tests carried out either by the supplier or the Inspecting Officer.

7.4 Final Acceptance:

Site Acceptance Test (SAT) certificate for the simulator shall be granted by Indian Railways to the supplier following installation of all system equipment at site, the successful demonstration and completion of the approved acceptance tests plan and acceptance of the submitted documentation package by Indian Railways.

Proving Test Certificate (PTC) for the simulator shall be granted by the consignee to the supplier after complete' installation of all system equipment, successful demonstration, and completion of approved acceptance test plan, and actual operation of the simulator system for a period of 4 weeks from the date of commissioning of the complete system.

7.5 Inspection:

7.5.1 Inspection:

The progress of work will be entered in the measurement book by the consignee and inspection certificate for completion of simulator building & hostel will be issued by the consignee in three stages as under –

i) Completion of foundation work
ii) Completion of roof work
iii) Completion of entire building with all facilities.

8.0 TRAINING:

8.1 The training programme shall be based on functional characteristics of Indian Railway Electric Locomotive Rolling Stock and Track. The scope, the duration, the people attending and their requisite qualifications be furnished in the offer.

The training programme shall cover :

a) Training of instructor in operation of simulator
b) Training in track building tool to generate new CGI of tracks.
a) Training for managers
d) Day to day routine maintenance of simulator hardware
e) Usage of software tools used in design of the simulator

The training shall enable IR personnel familiar with Railways and possessing computer knowledge to generate new features for developing realistic visual scene from scratch. It should not require advanced skills normally associated with developing of visual data base.

8.2 The supplier shall be responsible for developing training courses for Indian Railways personnel during the actual development stage. The training modules may be designed by selecting suitable sections of track with desired terrain features. The training modules shall take full advantage of the very high number of possible scenarios by combining the flexibility of alternate events available in the computer generated images system and the track building tools allowing to train drivers on specific territory and sensitive sections of the track. The design of the simulator training course must begin with examination of the train handling skills required by the drivers. Training modules shall be properly prepared to allow the drivers to be evaluated for specific train handling skills and trouble shooting skills. Supplier shall submit course contents to Indian Railways for review and approval.

8.3 Training programme shall consist of the following modules:

S.N.	Module	No. of personnel to be trained	Desired duration	Bare Min. Batch
i.	Instructor training	4 driver instructors per simulator.	3 weeks	4
ii.	Track building tool training	a)1 software engineer per simulator b) 4 software engineers from RDSO	6 weeks	5
iii.	Manager training	1 manager per simulator	4 weeks	2
iv.	Maintenance training for day to day routine maintenance	2 maintenance personnel per simulator	2 weeks	2
v.	Software training other than track building	a)1 software engineers per simulator b) 4 software engineers from RDSO	6 weeks	5

8.4 Supplier shall associate the Indian Railways' personnel while preparing the software as indicated in para 4.7 to train the Indian Railways' personnel not only in the preparation of the software (programming) but also to enable them to incorporate any software modifications in future. The supplier shall demonstrate that the production of all the numerical models simulating the physical behaviour of train circuits and automation systems avoid as far as possible manual encoding. Generic tools will be used to develop the simulator and IR personnel will be trained in the use of software. The supplier shall furnish evidence of having such software and tool, which can easily be improved by adding new track for visual data base. The supplier should demonstrate an equivalent tool used by any rail system, along with the level of satisfaction from the user of such tools.

8.5 Maintenance Training:

Supplier shall be required to provide training to Indian Railways maintenance personnel, covering the principles of operation and maintenance of the system. Course contents must include complete coverage of system hardware and software operating principles, preventive maintenance and subsystem trouble-shooting. Supplier shall be required to prepare and submit a summary of the course contents for review and approval by Indian Railways. In the offer, the supplier should indicate the training needs, both in terms of manpower and time duration.

9.0 BOUGHT OUT ITEMS:

The supplier shall furnish a list of all critical items/sub assemblies, which are bought out by the supplier and proposed to be used, alongwith the manufacturers name, brand and model. The supplier may be required to produce invoices to ensure genuineness of such products by the inspecting agency.

10. Consignee obligations:

The simulator will be equipped with a remote diagnostic and maintenance facility. For this, the consignee will have to provide two international telephone lines located in the simulator building premises- one line for modem connection and the second for telephone/fax support. All charges regarding installation/commissioning of telephone lines shall be borne by the Railways. The Railway shall ensure that the telephone lines shall be in operation before the arrival of equipment at site in functional order. Actual usage and rental charges for the telephones shall be borne by the firm. The consignee shall also provide the following, free of cost:

i. Clear site free of any encumbrance and accorded free access for transportation of material etc.
ii. Supply of electricity, air and water near the site.

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ANNEXURE-I

LEADING PARAMETERS:

1. CGI system main parameters shall be at least:

Resolution : 1280 x 720 pixels or more, consistent with the requirement of projection system
Image update rate : 60 Hz
Anti aliasing : Full screen 4x

The other graphical parameters of the CGI system should correspond to those of a professional 3D board, based on the nVidia GeForce 7800 chipset or better.

2. COMPUTERS

The main computer and other computers of the simulation system should be off-the-shelf high-end industrial PCs corresponding to the market state-of-the-art at the time of simulator design with sufficient expansion capability and spare capacity in terms of CPU, RAM and mass storage. These are only indicative. The computer system shall be delivered as per Industrial Standards for the similar application at the time of delivery.

Computer configuration is indicative only. The actual configuration may differ from this and will be depend upon the capability of hardware required to meet all design requirement specified in this specification and will be finalized in consultation with RDSO during design stage. Actual configuration will go on higher side of indicated configuration to achieve better results and realism.

The main parameters of simulator computers shall be at least:

i. Cabling between components with standard connectors, thermal protection devices and over-voltage protection devices
ii. Standard PC-based operating system and a powerful open-ended programming language (C ++)
iii. Operating Software : Latest Window Operating software.

A. CGI COMPUTER:

SN	Item	Configuration
1.	CGI computer	19" Industrial rack PC
2.	DVD burner	One
3.	Start PC CPU type and speed	Pentium 4 CPU – 3.06 GHz or higher.
4.	Central memory size (RAM)	1GB or more
5.	Graphic card	Geforce type ,latest.
6.	Hard disk size	80 GB or more
7.	Resolution of the CGI computer	1280 x 720 pixels or more
8.	Update rate of the CGI computer	60 Hz
9.	Number of colours of the CGI computer (display properties)	32 bits or more

B. HOST COMPUTER :

SN	Item	Configuration
	Host computer	Industrial 19" rack PC computer
	DVD burner	One
	Start PC CPU type and speed	Pentium 4 CPU – 3.06 GHz or higher.
	Central memory size (RAM)	1GB or more
	Hard disk size (drive properties)	120 GB or more

C. INSTRUCTOR COMPUTER:

SN	Item	Configuration
1.	Instructor computer	Industrial 19" rack PC computer
2.	DVD burner	One
3.	Start PC CPU type and speed	Pentium 4 CPU – 3.06 GHz or higher.
4.	Central memory size (RAM)	1GB or more
5.	Hard disk size (drive properties)	80 GB or more

D. VIDEO COMPUTER:

SN	Item	Configuration
1.	Video computer	Industrial 19" rack PC computer
2.	DVD burner	One
3.	Start PC CPU type and speed	Pentium 4 CPU - 3.06 GHz or higher.
4.	Central memory size (RAM)	1GB or more
5.	Hard disk size (drive properties)	80 GB or more

E. PROJECTION SYSTEM:

SN	Item	Configuration
1	Light output of projector	1500 ANSI Lumen or more
2	Resolution of projector	1280 x 720 pixels or more (refer clause no. 3.3.5 of the technical specification)

F. INSTRUCTOR CONSOLE :

SN	Item	Configuration
1.	LCD TFT monitors for CCTV display, CGI ,TPD and cab replicate panel	19"
2.	Instructor monitor	19"
3.	Key pad and mouse	One

G. OBSERVER STATION:

SN	Item	Configuration
1.	4 number 41" Plasma screens or any other better system for display of Close circuit camera, CGI, TPD and cab replicate panel	=
2.	Marker keys	6

The supplier shall specify in the offer the main characteristics of the proposed computers of the simulator system.

3. TYPICAL LOCO PARAMETERS:

SN	Parameter	Type of locomotive
1.	No. of axles	Parameters shall be as per 12000 HP, 8-Axle, IGBT based 3-phase drive freight electric locomotives to be procured vide RDSO 's Specification No. RDSO/2006/EL/SPEC/0044 (latest revision)
2.	Type of braking	
	i. Rgenerative	
	ii. Air Brake System	
3.	No. of drive cabs	
4.	Max. service speed Km/h	
5.	Total rated power at traction motor Armature shafts in H.P.	
6.	Loco weight in tonnes	

4. TYPICAL WAGON PARAMETERS

The list of wagons to be simulated for train configuration is as under:

BOXN,BOXNHS,BOXNHA,BOXNCR,BCN,BCNA,BCNHS,BRN,BRNA,BOBR,BOBRN,BOBYN,BTPN,BTPGLN,BFKN,BLCB,BLCA,BVZC,BVZ1

SN	TYPE OF WAGON	BOXN	BCN	BTPN	BVZC
1.	Length overhead coupler(mm)	9784	14500	11491	8540
2.	Bogie centres(mm)	6524	10000	8391	5400
3.	Nominal maximum axle load (tonnes)	20.32	20.32	20.32	20.32
4.	Tare (tonnes)	22.47	25.5	27.00	13.80
5.	Pay load (tonnes)	58.81	55.78	54.28	-
6.	Speed (km/h)	80/75	80/75	80	100
7.	Type of coupler	CBC	CBC	CBC	CBC
8.	Type of draft gear	MK-50	RF-361	MK-50	RF-361
9	Air brake system:	Single pipe graduated release.			

Note: The above-mentioned leading parameters are for guidance only. The technical details required by the supplier for the purpose of simulation will be provided by Indian Railway.

ANNEXURE II

Type of Sounds to be simulated in Cab:

(1) Sound of locomotive machine room available cab.

(2) Hissing sound produced by OHE while pantograph is lowered and lifted.

(3) Air related sounds such as those associated with air/EP/Auto brake release, bail off, and release of the whistle or sander valves.

(4) Sounds audible inside the cab coming from outside the cab environment with modulated volume characteristics of passage over bridges, passing rock cuts and abatements.

(5) Track clatter sounds associated with negotiating points and track crossings.

(6) Horns sound

(7) Wheel sounds that include the squeals- associated with negotiating curves as a function of curvature and speed.

(8) Brake shoes sound

(9) Brake binding, Wheel skidding and flat tyre sound

(10) Penalty / brake whistle

(11) Exploding detonators

(12) Passing train in same & opposite direction

(13) Tunnel / Bridge passing sound

(14) Normal axle movement on a metal bridge on points as a function of speed, slipping of the wheels and passing over points.

(15) Sounds from neutral section, roof, cab and HT compartment of the electric locomotives

(16) Platforms sounds including station announcements

(17) Compressor sound

(18) Rain/thunder storm sounds

(19) Chattering sound at the time of panto raising and lowering

(20) Blowing of safety valves

(21) Air dryers

(22) Accident/Derailment

(23) Buzzer sound for switching "ON" of flasher light

(24) Locomotive starting sound

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ANNEXURE-III

MALFUNCTIONS TO BE SIMULATED

The instructor should be able to introduce following malfunctions in the driving cab as well as on the trailing locos to be simulated on the head consist (As applicable):

1. Following malfunctions to be simulated in locomotive simulator as per equirement of the modelling:

i) Brake not acting
ii) Brake not released
iii) Train parting
iv) Head light failure
v) Horns failure
vi) Flasher light failure
vii) Brake binding and consequent dragging of load
viii) Alarm chain pulling
ix) No power/traction
x) Emergency guard brake
xi) MR and FP pressure not built up.
- Break Pipe continuity broken.
- Brake pipe angle cock closing: tail part venting.
- Brake pipe angle cock closing: head part venting.

xii) Vehicle Emergency valve operated
xiii) Leakage in MR, BP and FP
xiv) DAD power failure

2. SPECIFIC MALFUNCTIONS TO BE SIMULATED IN THE SIMULATOR:

Malfunctions for locomotive shall be simulated as per rquirement of 12000 HP, 8-Axle, IGBT based 3-phase drive freight electric locomotives to be procured vide RDSO 's Specification No. RDSO/2006/EL/SPEC/0044 (latest revision). The details will be finalised during design stage.

Note: Malfunctions with fault codes and functionality is displayed on the display unit located on the driver's cab

3. Track Malfunctions:

It is proposed to add following faults on the track as malfunction:

- collapsed catenary
- broken catenary
- collapsed track
- vehicle or animal on track
- Track immersed in water
- Blank / defective signal.
- Signals on Approach.
- Detonator bursting.
- Poor adhesion due to water / oil on track.

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ANNEXURE IV

The supplier to furnish the following information :

A. Main Computer:

i)	Central memory capacity	:
ii)	Number of Central processors	:
iii)	Number of graphic generation cards	:
iv)	Number and characterises of all other types of cards	:
v)	Main memory	:
vi)	Hard Disk Memory	:
vii)	Other details	:

B. Motion Base:

Motion platform shape	:
Stiffness	:
Pay load	:
Excursions:	
Roll	:
Pitch	:
Heave	:
Velocities:	
Roll	:
Pitch	:
Heave	:
Accelerations (non-simultaneous operational limits):	
Roll	:
Pitch	:
Heave	:
Smoothness	:

C. Capability & capacity of hardware & software:

ii) Number of wagons that can be maintained in the database.
iii) Maximum length of track parameters and visuals, which can be stored in the memory.

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ANNEXURE V-A

1.0 SCOPE OF SUPPLY OF SIMULATOR BUILDING:

The simulator will be housed in a separate building with built up area of 350sq.mt.The scope of work will include "design and construction of the building" and all related civil and electrical works on "turnkey basis". Special consideration shall be given towards the environmental requirements to be adopted for the particular building. The details of works and the relevant specification are described below.

The basic layout of the building shall be such that it shall be able to house the following facilities:-

a. Class Rooms for conducting training for two batches of 15 trainees simultaneously – Two nos.
b. Simulator Room to house in –motion- equipment with cab- One no.
c. Instructors room with adequate space for observer stations.- One No.
d. Technical and Electrical Room to house all simulator equipment. – One No
e. Maintenance Engineer's office.
f. Off line scenario creation room – One no.
g. Office Store Room to keep office files – One no.
h. Store Room for spare parts.- One no.
i. Entrance Lobby and Waiting Hall.
j. Pantry room – One no.
k. Toilets – Gents and Ladies separate one no. each
l. Outdoor covered space for accommodating DG sets.

2.0 DESIGN FEATURES:

The complete responsibility for the design of simulator building under turnkey project rests with the supplier. Therefore in case of any alteration found necessary in the design on account of technical requirement, the same shall have to be implemented by the supplier under turnkey responsibility.
The design methodology to be adopted for the design, detailing and construction of the building is as given below:

2.1 STANDARDS & CODES:

The relevant Indian standards and codes shall be referred for the design of Civil and Structural works. In all cases, latest revisions with amendments, if any, shall be followed.
Supplier shall get the soil investigation performed and a detailed soil report shall be submitted for approval. Founding depth of the building, type of foundations etc. shall be finalized based on the soil data received.
The entire simulator building will be constructed on single storey, however the building will be structurally designed for two storeys for future construction on first floor.
For the purpose of building design parameter, calculation of seismic forces, one zone higher than that mentioned in latest IS code should be considered.
The building shall be analyzed and designed as 3-D space frame model using software like STAAD – PRO (latest) or approved package.

2.2 FINISHING SCHEDULE:

2.2.1 Floor Finish

Mirror Stone Vitrified Tiles of approved colour size and make (BELL/Kajaria / Johnson) make shall be used as the flooring for the building. The tiles shall be of minimum size of 600 x 600 mm with the minimum thickness of 10 mm. The matching skirting of 100 mm height shall be provided.

The staircase as well as the steps in the entrance lobby shall be finished with kota stone, treads and risers along with kota stone skirting of 100 mm height.

Finishing of the counter top of pantry shall be done with granite slab of approved quality and colour.

Interior of the walls and roof shall be painted with plastic emulsion paint of approved colour and quality like ICI, Asian or Berger.

Exterior walls shall be painted with approved shade of Snowcem or other reputed brand.

External CI pipes shall be painted with approved shade of emulsion paint of approved quality (make Asian, ICI, Berger).

Walls of toilets and pantry shall be finished with dado of vitrified tiles of approved size quality and colour for a height of 2.1 m.

2.2.2 WALLS:

The internal face of all brick masonry walls shall be finished with cement plaster in 1:5 and external face shall be finished with cement plaster in 1:5 along with water proofing cement paint coating.
All ceiling area and soffit of staircase shall be finished with cement plaster.

2.2.3 ALUMINIUM DOORS / PARTITION / WINDOWS:

Main entrance door, internal partition to segregate stair case area and door leading to simulator lobby and all windows shall be made of aluminium sections of make "HINDALCO/JINDAL/INDAL". Glazing in windows/ doors shall be float glass of Modi / Tata/Saint Gobin transparent glass 4 mm / 5.5 mm. The windows shall be fixed with grilled frames All doors and windows shall be made dust proof. Hardware shall be of the approved brand and Mortice Lock – Six levers – Godrej or reputed make shall be used.

2.2.4 SANITARY FIXTURES:

Separate toilets for Gents and ladies shall be provided and shall have the following fixtures:-

E.W.C.	: Hindware or Pierry Ware
Wash Basin	: Hindware or Perry Ware .
Urinal	: Hindware or Peirry Ware
Mirrors	: 900 x 600 – Float Class Modi / Tata/Saint Gobin
Taps / Valve Angles	: Parko, Jaguar.
Pantry	: Stainless steel sink (With Drain board – 550 x 450 x 200 deep make ACM / Neel Kamal / Nirali).

2.2.5 PLUMBING:

All G.I medium quality as per IS:1239 / C.I. pipes shall be of I.S.I. of approved make.
Overhead Water Tanks shall be placed over Roof Terrace – 2 nos. 1000 liters each of Sintex make.

3. ELECTRIFICATION / LIGHTING:

The supplier shall carry out electrical /lighting design and provide cables, lighting fixtures/ exhaust fans and ceiling fans (where necessary) for all sections of the Simulator Building. All internal wiring shall be with copper cable with suitable earthing as provided in IS:732. The make of fittings, cables etc shall be of reputed make. The supplier shall submit the details of items and their make/brand for approval.
An electrical distribution panel providing power supply to the simulator, motion system and the building facilities and including a switchover between external grid and the DG set shall be designed and supplied. Suitable devises for protection from voltage fluctuation, surges, overloading etc shall be provided and furnished in the offer.

4. AIR CONDITIONING:

Spilt type Air conditioners shall be provided. The design of air conditioning in the building shall be as per operational requirement. All air conditioning units must be installed with suitable voltage stabilizer. The supplier shall furnish the detail of air conditioners to be provided in the building.

5. FIRE PROTECTION:

Fire extinguishers of suitable design and capacity shall be provided as per requirement. The details of the system offered should be furnished in the bid.

6. FURNITURE IN THE BUILDING:

The supplier shall provide necessary furniture to meet the functional requirements. The tentative list of furniture is as given below:

Description of Area	Furniture Detail	Quantity
Maintenance Engineer Room	Wooden Cup Board Chairs Desk	1 3 1
Off line scenario creation room	Wooden Cup Board Chairs Desk	1 3 1
Instructor Room	Chair for instructor Desk for instructor Monitors Chair for TBT Desk for TBT Tables for Observers Chairs for Observers Table for Observer monitors or projection screen for Observer images Wooden Cup Board Printer table	1 1 1 1 2 6 1 1 1
Class Room (Each)	Wooden Cup Board Chair for instructor Desk for instructor Chair for trainees	1 1 1 15
Store Room	Slotted angle Racks	4
Pantry	Wooden Cup Board	1
Reception	Reception desk Chair Cushioned settee with wooden head rest Center Table	1 1 1 1

7. WATER SUPPLY:

Potable water shall be supplied to basins, water closets, urinals, sinks, water coolers and other fixtures. A water cooler should be provided for drinking water purpose. Two number of water storage tanks of 1000 litres capacity each of Sintex make or equivalent shall be provided on the roof for supply of water for drinking purpose as well as for toilets. These tanks would be connected to Railway water supply.

8. DG SET:

The supplier shall supply 100 KVA silent type DG Set, so as to provide backup electricity to cover all operations of the simulator centre. DG Set shall be located outside of the building and shall be supported on RCC pedestal. D.G set should switch ON automatically and switch OFF automatically in case of power failure / resumption.

Complete technical details of the DG set indicating model no., make etc shall be furnished in the offer.

9. LANDSCAPING:

The peripheral area of the building (excluding plinth protection) approach road, walk ways shall be landscaped. It shall be for about 5 mtr. on the back as well as on the sides and not more than 20 mtrs. in the front area of the building. Soft landscaping including lawns, shrubs and trees shall be developed. The Supplier shall submit detailed drawing showing the soft area, walk ways, approach road, the type of trees, shrubs / grass to be planted and shall get it approved before the commencement of the job.

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ANNEXURE V-B

1.0 SCOPE OF SUPPLY OF HOSTEL BUILDING:

The hostel will be housed in a separate building with built up area of approx. 375 sq.mt on each floor comprising ground and 1st floors . The scope of work will include "design and construction of the building" and all related with civil and electrical works on "turnkey basis". Special consideration shall be given towards the environmental requirements to be adopted for the particular building. The details of works and the relevant specification are described below.

2.0 DESIGN FEATURES:

The complete responsibility for the design of hostel building under turnkey project rests with the supplier. Therefore in case of any alteration found necessary in the design on account of technical requirement, the same shall have to be implemented by the supplier under turnkey responsibility.

The design methodology to be adopted for the design, detailing and construction of the building is as given below:

2.1 STANDARDS & CODES:

The relevant Indian standards and codes shall be referred for the design of Civil and Structural works. In all cases, latest revisions with amendments, if any, shall be followed.

Supplier shall get the soil investigation performed and a detailed soil report shall be submitted for approval. Founding depth of the building, type of foundations etc. shall be finalized based on the soil data received.

The entire building will be constructed on double storey comprising ground and Ist floor, however the building will be structurally designed for three storeys for future construction on first floor. For the purpose of building design parameter, calculation of seismic forces, one zone higher than that mentioned in latest IS code should be considered.

The building shall be analyzed and designed as 3-D space frame model using software like STAAD – PRO (latest) or approved package.

2.2 FINISHING SCHEDULE:

2.2.1 Floor Finish

Mirror Stone Vitrified Tiles of approved colour size and make (BELL/Kajaria / Johnson) make shall be used as the flooring for the building. The tiles shall be of minimum size of 600 x 600 mm with the minimum thickness of 10 mm. The matching skirting of 100 mm height shall be provided.

The staircase as well as the steps in the entrance lobby shall be finished with kota stone, treads and risers along with kota stone skirting of 100 mm height.

Finishing of the counter top of pantry shall be done with granite slab of approved quality and colour.

Interior of the walls and roof shall be painted with plastic emulsion paint of approved colour and quality like ICI, Asian or Berger.

Exterior walls shall be painted with approved shade of Snowcem or other reputed brand.

External CI pipes shall be painted with approved shade of emulsion paint of approved quality (make Asian, ICI, Berger).

Walls of toilets and pantry shall be finished with dado of vitrified tiles of approved size quality and colour for a height of 2.1 m.

2.2.2 WALLS

The internal face of all brick masonry walls shall be finished with cement plaster in 1:5 and external face shall be finished with cement plaster in 1:5 along with water proofing cement paint coating.

All ceiling area and soffit of staircase shall be finished with cement plaster.

2.2.3 ALUMINIUM DOORS / PARTITION / WINDOWS:

Main entrance door, internal partition to segregate stair case area and door leading to simulator lobby and all windows shall be made of aluminium sections of make "HINDALCO/JINDAL/INDAL". Glazing in windows/ doors shall be float glass of Modi / Tata/Saint Gobin transparent glass 4 mm / 5.5 mm. The windows shall be fixed with grilled frames All doors and windows shall be made dust proof. Hardware shall be of the approved brand and Mortice Lock – Six levers – Godrej or reputed make shall be used.

2.2.4 SANITARY FIXTURES

Separate toilets for Gents and ladies shall be provided and shall have the following fixtures:-

E.W.C.	: Hindware or Pierry Ware
Wash Basin	: Hindware or Perry Ware .
Urinal	: Hindware or Peirry Ware
Mirrors	: 900 x 600 – Float Class Modi / Tata/Saint Gobin
Taps / Valve Angles	: Parko, Jaguar.
Pantry	: Stainless steel sink (With Drain board – 550 x 450 x 200 deep make ACM / Neel Kamal / Nirali).

2.2.5 PLUMBING:

All G.I.medium quality as per IS:1239 / C.I. pipes shall be of I.S.I. of approved make.

Overhead Water Tanks shall be placed over Roof Terrace – 4 nos. 5000 liters minimum each of Sintex make/ equivalent ISI make. Additional water tanks wherever necessary may be provided.

3. ELECTRIFICATION / LIGHTING:

The supplier shall carry out electrical /lighting design and provide cables, lighting fixtures/ exhaust fans and ceiling fans (where necessary) for all sections of the Building. All internal wiring shall be with copper cable with suitable earthing as provided in IS:732The make of fittings, cables etc shall be of reputed make. The supplier shall submit the details of items and their make/brand for approval.

An electrical distribution panel providing power supply to the building facilities and including a switchover between external grid and the DG set shall be designed and supplied. Suitable devises for protection from voltage fluctuation, surges, overloading etc shall be provided and furnished in the bid.

4. FIRE PROTECTION:

Fire extinguishers of suitable design and capacity shall be provided as per requirement. The details of the system offered should be furnished in the bid.

5. FURNITURE IN THE BUILDING:

The supplier shall provide necessary furniture to meet the functional requirements. The tentative list of furniture is as given below:

Description of Area	Furniture Detail	Quantity
Trainee Room	Single cot with matress Wooden Cup Board(in built in wall) Chairs Desk Table lamp	2 2 2 2 2
Kitchen	Wooden Cup Board Cooking range with cooking gas Chimeny and exhaust system Stainless steel utensils for cooking and dinning for 40 persons	2 2 2 2 sets
Store Room for Kitchen	Slotted angle Racks	2
Store Room for linen, mattresses etc	Slotted angle Racks	4
Dinning Hall	Dinning Table Chairs Water Purifier Wooden Cup Board	2 24 2 4
Reception cum Care taker's room	Reception desk Chair Cushioned settee with wooden head rest Center Table	1 1 1 1 1
Library cum Reading room	Chairs Desk Wooden Book Shelf	10 10 5
Recreation room	Sofa set T.V – 29 inches	2 1
Meditation Room	Wall to wall carpet	1

6. WATER SUPPLY:

Potable water shall be supplied to basins, water closets, urinals, sinks, water coolers and other fixtures. R.O system of adequate capacity shall be provided for the purpose of drinking water. A water cooler should be provided for drinking water purpose. Four number of water storage tanks of 5000 litres capacity each of Sintex make or equivalent shall be provided on the roof for supply of water for drinking purpose as well as for toilets. These tanks would be connected to Railway water supply.

7. STANDBY POWER SUPPLY ARRANGEMENT:

The supplier shall provide backup electricity to cover two lights, one fan and one bath room light for each room by inverter of suitable capacity.

Complete technical details of the inverter indicating model no., make etc shall be furnished in the offer.

8. LANDSCAPING:

The peripheral area of the building (excluding plinth protection) approach road, walk ways shall be landscaped. It shall be for about 5 mtr. on the back as well as on the sides and not more than 20 mtrs. in the front area of the building. Soft landscaping including lawns, shrubs and trees shall be developed. The Supplier shall submit detailed drawing showing the soft area, walk ways, approach road, the type of trees, shrubs / grass to be planted and shall get it approved before the commencement of the job.

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