

Technical Specifications Document

Supply of complete integrated Virtual Reality System along with Installation, Commissioning, Integration and Training

1. Introduction

Institute for Plasma Research (IPR) is an autonomous research organization under Department of Atomic Energy (DAE) and is located at Gandhinagar, Gujarat. IPR is involved in research of various aspects of plasma science including basic plasma physics, magnetically confined hot plasmas and Plasma technologies for industrial application with special emphasis on thermo-nuclear fusion reaction. IPR is also one of the seven partners in the International Thermo-Nuclear Experimental Reactor (ITER), Cadarache, France.

Remote Handling and Robotics Technology Division (RHRTD) at IPR, with major objective to develop high precision Robotics equipment for remote handling of the installation and maintenance process of the different components of the fusion reactor, is in the process of setting up a Virtual Reality (VR) facility aiming to acquire full autonomy in the intensive use of the VR tools in design, simulation, analysis and maintenance operations online/offline carried out by Remote Handling (RH) equipment outside/inside the tokamak machine.

The following tender document outlines the need of VR for various applications as a part of the RH development at IPR.

2. Objective

Remote operations require an accurate perception of a dynamic environment. The aim is to give the operators the same unrestricted knowledge of the task scene as would be available if they were located in the remote environment. In fact, the Virtual Reality (VR) system can give an overview over the entire scene which is better than being present at the workplace. In addition, different algorithms will be integrated with the VR system like collision avoidance algorithms, path planning algorithms etc.

The objective is to develop a Virtual Reality facility at IPR for the Remote handling design simulations and analyses activities. Virtual reality systems are an indispensable tool for many remote handling activities, from initial equipment concept evaluation to the monitoring of remote handling operations. This VR system will cater the preparation and support of remote handling operations at IPR. It will help to gain experience and expertise in development of system specific RH equipment. The system also aims act as a training facility for engineers to advance in the field of remote handling and robotics for future needs.

The main aim of VR facility is to provide the complete 3D view of the RH operations to be carried out inside/outside of the tokamak and enable an operator to handle and control those operations remotely via haptic devices in the RH control system.

3. Scope of Work

The scope of this tender is to establish a comprehensive Virtual Reality facility. The Integrator/Bidder is required to establish the VR set-up including the supply and commissioning of equipment with supporting software (available at IPR) CATIA, DELMIA (compatibility to V5-R23) and 3D-Via Composer and full operations with demonstration including training with 3 years comprehensive warranty.

The lab will comprise of the following:

1. Fully integrated Display Systems vise screen, screen supports, projector, projector supports, tracking etc.
 - High resolution display including:
 - a) 3-Sided seamless display screen with screen support structures.
 - b) Screen and Projector mechanics for proper support and functioning.
 - c) Projectors with native resolution of 1920 x 1200 or more with projector support, wiring, setup, connectors, standard input/output, control, networking and accessories.
2. A 6 DOF optical tracking System
 - a) Tracking system integrated into complete VR setup. (Tracking camera and support, wiring, setup, software compatible with available software at IPR i.e. CATIA, DELMIA (compatibility to V5-R23) and 3D-Via Composer)
 - b) 3D Active Stereo glasses and emitters.
3. Real time 3D Visualization Software
 - a) Real time visualization software shall be integrated into the VR system architecture
4. On site display system/operator training.
 - a) On site demonstration of RH applications provided by IPR using the VR set-up. Integrator/Bidder should be able to represent the full application on-site after the VR set-up is completed. There should not be any data loss, CATIA Models and simulation programs will be made available to the Integrator/Bidder by IPR.
 - b) Integrator/Bidder has to convert them in 3D using the real-time visualization software and should demonstrate full tracking for multiple users and virtual interface.
5. All the necessary hardware and interconnects

4. Technical Specifications

There are various components of the proposed VR facility. The following are specifications of each of the components.



[Illustrative Image used for representation purpose ONLY]

4.1 Fully Immersive 3D Projection and Display System

The general requirements of the projection and display system are -

- A complete solution including projectors, display screens, stereoscopic glasses, mounting structure, tracking system and with all necessary hardware accessories should be quoted by the Integrator/Bidder
- The three display surfaces meet at a point in front of the user
- Detailed drawings of the Projector, Screen and Mirror arrangements to get required display parameters on each screen and viewable area has been submitted along with offer. The Integrator/Bidder has to confirm compatibility of the proposed Projection systems, Screens and tracking devices with each other. The proposed projection-display system and its mechanisms should be totally interconnected with all components within the set footprint or space available.
- The Integrator/Bidder should also take care on Installation / Integration with all inter connects required for the system.
- The Integrator/Bidder should note that the maximum space available for the complete VR system is as follows:

Available Space at IPR for complete VR system	Height	5m max
	Width	6m max
	Depth	7m max

The complete projection and display system is divided into the Screen & Screen Mechanism, Projection & Projection Mechanism and Stereoscopic Glasses units. The following are the specifications of each of these units.

4.1.1 Projection & Projection Mechanics

One projector per screen segment to be provided (Qty – 3 Nos)

Image	<ul style="list-style-type: none"> Brightness: Minimum 6000 ANSI lumens @ 200-240V Uniformity: 80% brightness uniformity or better Rear Projection for Front and Side screens and, Front projection for Floor screen
Number of Projectors	<ul style="list-style-type: none"> There should be only single Projector for each screen Total : 3 Projectors
Display	<ul style="list-style-type: none"> Type: The offered display environment needs to be a seamless edge blended display created using a high-resolution 3 chip DLP / Darkchip 3 or better /equivalent projection system Native resolution: WUXGA (1920 x 1200) or higher at all frequencies from 96 – 120 Hz with 3D stereo sync outputs
Resolution per facet	<ul style="list-style-type: none"> Two at 1920 x 1200 or better (Front and Floor) One at 1200 x 1200 or better (Side)
Total Resolution	<ul style="list-style-type: none"> 6 Megapixel or higher
Aspect Ratio	<ul style="list-style-type: none"> Two at ~16:10 One at 1:1
3D Capability	<ul style="list-style-type: none"> The projectors should be Active stereo3D and should support 120Hz input at above mentioned resolution
Light Source	<ul style="list-style-type: none"> High quality Lamp/ Laser Life of Lamp Source: 1500 Hours or higher
Standard Input	<ul style="list-style-type: none"> DisplayPort – 2 Nos. or higher Dual-link DVI – 1 No. or higher HDMI – 1 No. or higher 3D Sync Connector
Inputs/outputs, control and networking	<ul style="list-style-type: none"> RS232 In/Out Ethernet (RJ 45)
Lens	<ul style="list-style-type: none"> Fixed : 1.1:1 or better
Standard Accessories	<ul style="list-style-type: none"> Power cables, Display Cables and all inter-connectors

	<ul style="list-style-type: none"> • 3D sync card
Power	<ul style="list-style-type: none"> • Operating voltage: 230 ± 10% VAC @ 50 Hz
Operating environment	<ul style="list-style-type: none"> • Temp: 10 to 40° C

For the projection on the Floor screen only, a first surface mirror arrangement must be used to fold the light and cut down on the space used for projection throw from the projector to the screen.

The warranty as per Warranty Clause (Section-C-Section 10)

Projector Mechanics: (Qty – 3 Sets)

- Suitable projector mechanics to hold the projector to be provided.
- The material used for this structure should be of adequate tensile strength/ OEM recommended to hold the projector stably without oscillations or vibrations including micro vibrations.
- This structure should be with a six degree of freedom base with automated or motorised control to keep the projector aligned and allow for movement as per the requirement at site.

The warranty as per Warranty Clause (Section-C-Section 10)

4.1.2 Screen & Screen Mechanics

The VR facility is proposed to have an integrated three (3) screen display system. This includes a front, a side and a floor. The following are the required specifications of Display Screens and its mechanism.

Screen size and type	One 3.2 to 3.5m x 2 to2.2m soft screen (Front) One 2 to2.2m x 2 to2.2m soft screen (Side) One 3.2 to 3.5m x 2 to2.2m soft screen (Floor)
----------------------	--

Projection Screen: L type screen + Floor as mentioned above with the following specifications for the screen material. (Qty – 1 Set)

Front and Side Screens with rear projection:

- Type of material : Flexible Screen (fabric)
 - Peak Gain : 1.0 or better
 - Half gain : 60 + Degrees
 - Minimum Throw Distance : 1.0 X Image Width or higher with fixed lens
 - No banding should be visible on the edges of the screens
 - There should be smooth blending and matching of the images at the edges of the different screens
 - It Should be flame resistant
 - When laid flat, there should not be any crease.

Floor Screen with front projection

- Type of material : Flexible Screen (fabric)
- Peak Gain: 1.0 or better
- Half Gain: 60 + Degrees
- Ambient Light Front Reflectance Value: 80% or better
- Ambient Light Resistance: Fair
- Minimum Throw Distance: 1.0 x image width or higher
- No banding should be visible on edges
- Should be flame resistant
- When laid flat, there should not be any crease.
- If user needs to wear any kind of special material shoes, The details must be supplied by Integrator/Bidder

The warranty as per Warranty Clause (Section-C-Section 10)

Screen Mechanics: (Quantity – 1 Set)

- Suitable structure with adequate strength/OEM recommended to be provided to hold the screen material in the three sided pattern as mentioned above
- The warranty as per Warranty Clause (Section-C-Section 10)

4.1.3 Stereoscopic Glasses: (Qty – 20 Nos.)

- Sync Operation : IR/RF
- Transmission in Clear State : 30 % or better
- Residual Light : 15% or better
- Contrast : > 200:1 (no Ghosting)
- Weight :< 60 grams
- The warranty as per Warranty Clause (Section-C-Section 10)

4.1.4 Stereoscopic Emitter: (Qty – 2 Nos.)

- IR/RF
- Compatible to the proposed stereoscopic glasses
- Max Emitting Range : 5m or higher
- The warranty as per Warranty Clause (Section-C-Section 10)

4.2 Tracking System

The tracking devices are the one of the major components for the VR systems. They interact with the system's processing unit. This relays to the system the orientation of the user's point of view. In systems which let a user to roam around within a physical space, the locality of the person can be detected with the help of trackers, along with his direction and speed.

The general requirements of the tracking system are –

- The tracking should be completely camera based motion tracking.

- **The tracking system should be compatible to the Real Time 3D Visualization software (Section 3), Projection systems, Screens and all other quoted items.**
- The user should not need to wear any kind of detectors or special clothing.
- Integrated system should allow typical virtual prototyping operations like grabbing, rotating, moving and placing a 3D object in the virtual scene.
- The tracking should come with the supporting controller and software.

The following are the detailed specifications of the tracking system

4.2.1 Tracking Camera (Qty 4 Nos.):

- Infrared optical 6 DOF tracking camera, to work with active/passive markers.
- Inbuilt infrared flash (NIR)
- Max. tracking distance: up to 5 meter or more
- Frame rate : 120 Hz
- Modulated flash for active marker synchronization
- Standard focal length: $f = 3.5$ mm or better
- Cable for Data out : Fire-wire
- Camera Sync: Ethernet

4.2.2 Controller (Qty: 1 No.):

- Easy remote access through front-end software
- Data output via Ethernet
- Simple camera and target management
- Flexible adjustment of room and body coordinates
- Convenient configuration management
- Software Interfaces: trackd, VRPN or direct via SDK
- Open-Tracker Support and API should be provided.

4.2.3 Wireless joystick & Head-Tracking: (Qty – 2 Nos. Each)

Interactive wireless joystick is used for manual manipulation of virtual objects and targets for stereo glasses with following specifications.

- 6 DOF tracking
- Analog/Digital joystick and minimum 6 buttons
- Wireless transmission (ISM band)
- Protected passive target
- Use of more than one Wireless joystick simultaneously should be available.

The warranty as per Warranty Clause (Section-C-Section 10)

4.3 Real Time 3D Visualization software for Virtual Reality Facility (Qty: 1No.):

A compatible Real Time 3D Visualization software module is required to create the fully immersive 3D data set from CATIA, DELMIA (compatibility to V5 R23) and 3D Via Composer and seamlessly distribute to the 3 screens in real time. The rendering should not require any data conversion or limitation for resolution, shape or performance. The visualization software should enable 3D applications to operate with various display systems and act as a 3D display driver for the entire VR facility with the ability to work directly within the 3D applications from workstations and render the 3D model display in real-time on the immersive VR facility. The general requirements of the 3D visualization software are as follows –

- Display seamlessly the 3D models in Real Time to the proposed VR facility (3 Sided Display System)
- No data conversion or limitation for size, resolution, shape or performance during rendering
- Display of 1:1 scale models or greater without any sort of data conversion or data loss
- Interaction with model in real time using tracked devices (Section 2)
- Features for interactive decision making

The following are the specifications of the Real Time 3D Visualization software:

S.No	Parameters	Specifications
1	Features	<ul style="list-style-type: none"> - Transparently display the existing 3D application on specified display system (See Section 1) - No data conversion. No export or import process should be required should be required from the native CAD application. - No Programming should be required. It should be plug and play type system to visualize any model in immersive 3D - The Solution should be seamlessly compatible for interaction of the 3D models using a 6DOF Force feedback haptic device
2	Software Compatibility	<ul style="list-style-type: none"> - No data conversion. No export or import process should be required from the native CAD application Dassault Systems CATIA, DELMIA (compatibility to V5-R23) and 3D-Via Composer - No Programming should be required. It should be plug and play type system to visualize any model in immersive 3D

		<ul style="list-style-type: none"> - 3D applications supported should be Dassault Systems CATIA, DELMIA (compatibility to V5-R23) and 3D-Via Composer
3	Display System Compatibility	<ul style="list-style-type: none"> - Visualization Software should be a middleware solution to display directly any existing 3D applications on 3 Sided Fully immersive display system without making modification of the existing 3D application or importing into a separate application integrating tracking information for immersion and providing a broad range of functionalities and scenarios of use. - The visualization software should support the minimum frame resolution of 1920x1200 per screen for the front and side projections and 1200x1200 per screen for the floor projection
4	Architecture	<ul style="list-style-type: none"> - The Visualization Software should grab the 3D content (3D models) from unmodified existing 3D OpenGL applications, running on one main workstation, and sends it in real time to the cluster of computers connected to the projection system.
5	Tracking System	<ul style="list-style-type: none"> - The solution should allow to combine information from any the specified tracking system, VRPN compliant, to the VR environment. - The solution should enable to create a VR experience by computing the appropriate stereoscopic point of view combining models, stereoscopic projection and head tracking. - The Solution should be seamlessly compatible to the proposed 6 DOF tracking system.
6	Native Applications	<ul style="list-style-type: none"> - The models are displayed exactly in the same way as in the original application. If the native application has textures, shaders or post-processing effects (real time compliant), the solution should display them. - If the application can play an animation in real time, the solution should display the same animation also in real time.
7	Stereo Functionality	<ul style="list-style-type: none"> - The solution should enable to add stereo to non-stereo application without modifying the original application.
8	Navigation Functionality	<ul style="list-style-type: none"> - The user shall have the choice to either navigate in the original application, using the mouse and keyboard inputs, or to use a tracked Navigation device (6DOF wireless

		<p>joystick/ haptic arm) and navigate in the VR environment.</p> <ul style="list-style-type: none"> - The navigation performance in the VR environment with the solution is accelerated compared to the original application. There is no need optimize or simplify the datasets for the project review. The solution shall integrate and interface with the Navigation device.
9	Licensing	<ul style="list-style-type: none"> - The licenses must be perpetual
10	Cluster Compatible	<ul style="list-style-type: none"> - Software should have capability to run across a multiple PC cluster to increase render and computer performance
11	User Tools	<ul style="list-style-type: none"> - Software should allow user to work on the model from the native application with a navigation device in stereo mode. - The following functions should be accessible in the VR environment: bookmarks recording, measurement between points in the model, clipping plane and zoom, snapshot, hide and show part, annotations in stereo image output on the main display screen, animation recording and video exporting. - The bookmark functionality should enable the user to record a set of model view positions and to go back to these positions later, during the same session or in another review session. - The measurement functionality should enable the user to select two points in the model and measure the distance between those two points. Furthermore the measurement tool should offer the possibility to measure angle between surfaces or diameter of circle shape by adding 3 points on this circle - The user can place and move a clipping plane that provides a section of the model (as it is) to see the inside content. Adding more clipping planes should be offered. - The zoom functionality should enable the user to change interactively the scale of the model to have a better view of the details. Zooming in or out, decreasing or increasing the scale of the model should be the 2 possible actions. Coming back at scale 1 should be offered easily. - The snapshot functionality should enable the user to take a picture of the current model view as image file (jpg, png, gif), that can be saved on the main workstation for paper report. - The hide & show parts functionality should enable the user to select interactively some parts of the model and hide

		<p>them to have a better understanding of the important parts of the model</p> <ul style="list-style-type: none"> - The annotation functionality should provide the user a way to stick interactively virtual flags on the model to point out specific issues seen during the review. This annotation should be saved as VRML files, to be uploaded in 3D native application - Animation Recording should enable the user to record his walkthrough and save it as an animation. Such animation can be later replayed with the same 3D model in VR. - Software Video Recording should enable the user to record all actions and model navigation and export that as a AVI movie for review debriefing, training or product documentation
--	--	---

4.4 10-Gigabit Ethernet Managed Switch (Qty: 1No.):

1	Number of Ports	Minimum 24
2	Buffer size	3 MB or more
3	SFP ports	Min. 04 SFP+ 1000/10GBASE-X fiber ports (dedicated)
4	Operating temperature	0° to 50°C
5	MTBF (@ 25° C)	500,000 hours or more

4.5 Audio System (Qty: 1No.):

A commercial quality 5.1 Surround Sound audio system needs to be supplied and installed with the system to ensure maximum immersion. This system is to be Ethernet (RJ45) controllable via the control system.

The technical specifications of the system components include the following:

1	Inputs/Outputs	<ul style="list-style-type: none"> • 4x HDMI inputs or more • 2x optical digital audio connections or more • 2x coaxial digital audio connections or more • Analogue L/R audio inputs • 1x 3.5 mm connection • Ethernet port control and updates via network
2	Supported Audio Format	<ul style="list-style-type: none"> • Dolby Digital, • Dolby Digital Plus, • Dolby TrueHD, • Multichannel PCM

3	Amplifier	<ul style="list-style-type: none"> • Rated Output Power: <ul style="list-style-type: none"> - 2Ω Dual (per channel) 550-775W, - 4Ω Dual (per channel) 350-525W, - 8Ω Dual (per channel) 300W, - 8Ω Bridge ~1000W, - 4Ω Bridge ~1,500W. • Crossover frequency: 50Hz to 3kHz • Amplifier Class D • Load Impedance: 2 to 8 ohms per channel in stereo, 4 to 8 ohms in Bridge Mono.
4	Surrounding Speakers	<ul style="list-style-type: none"> • Frequency range: 40Hz to 19KHz (-10dB) or better • Power Capacity: 300 W or more with continuous program power • Nominal Impedance: ~8 ohms
5	Sub-Woofers	<ul style="list-style-type: none"> • Frequency range: 42 Hz - 200 Hz (-10 dB) • Frequency response: 48 Hz - 120 Hz (± 3 dB) • Power Capacity: 800 W or more with continuous program power • Nominal Impedance: ~8 ohms
6	Microphones	2 Nos. of wireless mics

5. Deliverables

1. Deliver and install the VR equipment at IPR site (first operation place) inclusive Acceptance)
 - a. Delivery of all visualization systems (screen, screen support, projector and projector support)
 - b. The Real Time tracking system integrated into the complete VR system (tracking cameras and supports, stereoscopic glasses and IR/RF emitters ,wiring, setup, software)
 - c. Documentation and procedures for commissioning of the complete VR platform and visualization software, integrated to CATIA, DELMIA (compatibility to V5-R23) and 3D-Via Composer
 - d. Interconnection of all computational systems and network configurations.
 - e. The Integrator/Bidder should also take care on Installation / Integration with all the inter-connects required for the system.
2. The Integrator/Bidder has to ensure minimum 3 years comprehensive warranty from the date of successful commissioning including software updates and technical service
3. Initial training for IPR related personnel to be able to operate the VR platform (display systems and operator training).

IPR Roles and Responsibilities

- a. IPR will provide a room with required civil work and electric connections at one point. The Integrator/Bidder should not quote any items that require 'clean room' conditions.
- b. IPR will provide the civil and infrastructure necessary for the establishment of the Virtual reality facility. **The Integrator/Bidder shall provide a complete specifications of the civil and infrastructure requirements to IPR at least 3 months prior to the delivery of the system**
- c. IPR will provide the necessary computational hardware for the Virtual reality facility. **The Integrator/Bidder shall provide a complete specifications and quantity of the required computational hardware to IPR at least 3 months prior to the delivery of the system**

Integrator/Bidder's Obligation

- a. Setting-up of the VR Facility with single point responsibility on the Integrator/Bidder. This will include amongst others supply of all necessary hardware, software, Projection system, design of the VR Facility, installation of hardware, installation and configuration of software, and training on the system.
- b. Supply of Interconnecting Equipment's/ Components: Necessary cables, interfaces and extenders shall be supplied by the Integrator/Bidder. It is the Integrator/Bidder's responsibility to select & deliver the best performing & compatible sub-components like cables & interfaces to deliver a completely integrated solution.
- c. The Integrator/Bidder must submit along with the technical bid, the complete list of items that will be delivered to IPR against this tender.

6. Pre-Dispatch Inspection

Pre-Dispatch Inspection for the system is necessary of the complete VR system. The PDI is to be conducted before the dispatch of the components to IPR at a site (local/foreign) as per the convenience of the Integrator/Bidder in presence of IPR personals. The complete VR facility should be installed and demonstrated. This will include the projector, projector mechanics, screen (3 Sides), screen mechanics, 3D rendering software.

1. The following will be testing requirements to be completed at the PDI site.
 - All components will be checked as per the specification sheet and various terms and conditions specified in different sections of the tender Projector
 - The complete VR facility system should be erected for demonstrations.
 - Projector brightness should be tested using Lumens meter.
 - Active 3D glass should be tested from maximum distance of emitter as per specification.

- Emitter should support specified number of glasses.
- No Hotspot should be detected in Flexible Projection screen.
- No banding should be visible on the edges.
- The tracking system should be installed completely able to track all the stereoscopic glasses with passive markers and wireless joysticks.

2. Demonstrate functionality of Real Time 3D Visualization software and tracking system to display directly existing 3D application (CATIA, DELMIA 3d-Via Composer) on the 3D immersive display systems, integrating tracking information for immersion and interaction.

- Following functionalities of the Real Time 3D Visualization software must be demonstrated:-
 - i. Perform the following operations in immersive VR view:-
 - a. Immersive 3D visualization of the CAD data in 1:1 scale from native applications (CATIA, DELMIA 3d-Via Composer) available with IPR without any format or data conversion and without exporting of models to the 3rd party applications other than the native CAD application. The Real Time 3D Visualization software should be a middleware only.
 - b. Show VR interaction with tracking system and VR real time software functionality including object pick, flythrough, sectioning, image capture,
 - c. Show VR functionality like measuring distances between objects, hide & show model and video recording
 - d. Show collision detection with and without interpenetration
 - e. Show natural interaction with objects in the scene, in VR view
 - f. Create a bookmark, take annotation and save them as text for feedback post the review session
 - ii. Save the review session and reopen the saved review session again

3. Accuracy testing (For accuracy testing, all models will be given by IPR)

- Rotational : permitted errors ≤ 1 %
- Translation : permitted errors ≤ 1 %
- Delay : permitted delay up to 0.5 sec
- Performance range : All parameters should be perfectly working in the specified range
- Field of View : permitted errors ≤ 1 degree

7. Delivery Schedule

The Integrator/Bidder has to deliver the system as per the following schedule

Sr.	Detailed Descriptions	Estimated
-----	-----------------------	-----------

No.		Time
1.	PO release	T0
2.	Production of the complete BOM for the complete VR facility	T0 + 4 weeks
3.	Pre-Dispatch Inspection	T0 + 28weeks
4.	Commission of VR facility/completion of all activities including site readiness.	T0 + 30 weeks
5.	Site Acceptance Tests & training	T0 + 32 weeks

8. Site Acceptance Criteria

All the components on their delivery to IPR will be checked as per the specification sheet and various terms and conditions specified in different sections of the tender.

1. Projector

The projectors and accessories will be checked as per the specification sheet and various terms and conditions as specified in different sections of the tender.

Test certificate of following items should be provided with delivered item

- Lamp of projector
- Lens of projector
- Residual Light and transmission in Clear State of glasses
- Wavelength of emitter

2. Screen

The screen and accessories will be checked as per the specification sheet and various terms and conditions as specified in different sections of the tender.

- It will be checked on the assembled screen, there should not be any crease, when laid flat to the prescribed dimensions.

3. Tracking System

The Tracking system and accessories will be checked as per the specification sheet and various terms and conditions as specified in different sections of the tender.

Test certificate of following items should be provided with delivered item

- IR source
- Cable connections
- Power Supply

4. Integration

The Integration of various components and systems will be checked as per the specification sheet and various terms and conditions as specified in different sections of the tender.

5. Assurance of Compatibility.

The VR peripherals and supported software should be fully compatible with CATIA, DELMIA (compatibility to V5-R23) and 3D-Via Composer. The Integrator/Bidder should demonstrate and prove the compatibility of VR peripherals and respective software or SDKs with the same on-site.

6. Accuracy testing (For accuracy testing, all models will be given by IPR)

- a. Rotational : permitted errors $\leq 1\%$
- b. Translation : permitted errors $\leq 1\%$
- c. Delay : permitted delay up to 0.5 sec
- d. Performance range : All parameters should be perfectly working in the specified range
- e. Field of View : permitted errors ≤ 1 degree

9. Training

The level of training imparted should be detailed to ensure that the modelling and simulation facility can be handled independently by IPR engineers. The Integrator/Bidders are to provide the details of the course contents (syllabus) for the training. The training must ensure capability towards realistic rendering and high level interactivity reproducing the complexity of RH system integration in Real World. It should give the user the possibility to test and implement several scenarios by putting characters in line situation and also ensure multi user mode. The detailed training for the Real Time 3D Visualization software should be provided by the OEM prior to the installation of the system as this will ensure complete participation of IPR during the installation and testing phase of the VR facility at IPR.

1. The level of training imparted should be detailed to ensure that the modelling and emulation facility can be handled independently by IPR.
2. Complete documentation for the operation, maintenance and troubleshooting of the facility are to be provided in both soft and hard copies.
3. Separate training should be provided for each and every components. Complete training material to be provided in both hard and soft copies.
4. Component specific training should be provided for Tracking system, Screen and Projector setup, computational system setup, network configuration of minimum 2 days each
5. Advanced Training should be provided by OEM for Real Time 3D Visualization software prior to the delivery of the system. This should also include software integration with CATIA, DELMIA, and 3DVIA (minimum of 1 week training).

6. Visualization training should be provided on the complete integrated VR system by the Integrator/Bidder/solution provider for rendering of CAD models from available software at IPR to the VR facility.
7. The training must ensure capability towards realistic rendering and high level interactivity reproducing the complexity of RH system integration in Real World.
8. The Integrator/Bidders are to provide the details of the course contents (syllabus) for the training.
9. It should give the user the possibility to test and implement several scenarios by putting characters in line situation and also ensure multi user mode.
10. The training should be to the satisfaction of IPR

10. Warranty

1. All the equipment including third party items in VR Facility at IPR, shall have to be covered by a comprehensive warranty for Three (3) years after successful commissioning and acceptance at IPR site.
2. The warranty on the mechanical structures for screen and projectors should be for a period of minimum.10 (ten) years
3. Bidder has to provide the list of critical spares to be stocked along with the bid for the smooth running of the VR facility.
4. Warranty should also include supply of all the software upgrades with necessary additional hardware, if any, free of cost.
5. In case of any defect (as per the General terms & conditions under Warranty clause), during warranty, the supplier shall arrange to replace / repair the defective item at his own cost at IPR site.
6. The system shall have to be repaired within a period of 2 working days from the time it is reported.
7. In case of major breakdown, which require spares other than the stocked spares the system have to be repaired within a period of 120 hours from the time it is reported.
8. The accommodation, transport etc. of the service engineer will be totally on Supplier's account.
9. In case, if any item is covered by warranty of more than Three (3) years, Supplier must pass on the benefit arising out of the same to the IPR.
10. During the warranty period, supplier will arrange for servicing and calibration of the display system and projectors for VR facility every six months.
11. The Integrator/Bidder has to migrate / transfer application / applications license(s) free of cost during the warranty period, if condition so arises.
12. In case of suppliers failure to repair as per clauses 5 & 6 above a penalty on pro-data basis shall be levied @ 0.5 % per week of the cost of the entire project which will be paid by the supplier within 30 days.