

Sr No	Volume	Portion	Page	Clause	Existing para / sub- para/ clause		Amendments		
					Date & time of Submission of Tender	Date & time of opening of Tender	Deleted	Modified	Modified para / sub- para/ clause/ New Clause
1	Volume-01	NIT	Pg No 02	1.1.2	26.10.2020 up to 15:00 Hrs.	26.10.2020 @ 15:30 Hrs.		✓	26-10-2020 09.11.2020 up to 15:00 Hrs. 26-10-2020 09.11.2020 @ 15:30 Hrs.
2	Volume-01	ITT	Pg No 208	Appendix C	Details of Railway Authority Locations where Proposed Equipment is in use on other Passenger Carrying railways			✓	The heading of column No 05 of Appendix C shall be read as: - "Details of Railway Authority: Details of Railways/Metro/LRT/Monorail/Large Infrastructure Project/Airport" The heading of column No 06 of Appendix C shall be read as: - "Locations where proposed Equipment is in use on other- Passenger-Carrying railways-in Railways/Metro/LRT/ Monorail/ Large Infrastructure Project/Airport"
3	Volume-01	ITT	Pg.No 27/ITT & Pg No 41/ITT	C.19.1 & F5.1	The Tenderer shall submit full details of the identity of the proposed parties who would respectively provide or issue: (a) Performance Security in accordance with Sub-Clause 4.2 of the GCC; (b) Parent company Undertakings in accordance with Clause 4.2 of the GCC; (c) Parent company Guarantees in accordance with Clause 4.2 of the GCC; The Performance Security required in accordance with Clause 4.2 of the GCC shall be for 10% of the Contract Price from the Scheduled commercial Bank (including Scheduled Commercial Foreign Banks) in India in the currency in which the Contract Price is payable. The Performance Security shall be furnished to the Employer within 30 (thirty) days of receipt of the Letter of Acceptance. The form of Performance Security is provided in Schedule -2 of SCC.			✓	(a) Performance Security in accordance with Sub-Clause 4.2 of the GCC; (b) Parent company Undertakings in accordance with Clause 4.2 of the GCC; (c) Parent company Guarantees in accordance with Clause 4.2 of the GCC; The Performance Security required in accordance with Clause 4.2 of the GCC shall be for 10% of the Contract Price from the Scheduled commercial Bank (including Scheduled Commercial Foreign Banks) in India in the currency in which the Contract Price is payable. The Performance Security shall be furnished to the Employer within 30 (thirty) days of receipt of the Letter of Acceptance. The form of Performance Security is provided in Schedule -2 of SCC.
4	Volume-01	ITT	Pg No 239	2	"Time for completion" of the work from the date of commencement of the work (Clause 8.2 of the GCC); 40 months				"Time for completion" of the work from the date of commencement of the work (Clause 8.2 of the GCC); 49 36 months
5	Volume-01	ITT Annexure-2	Appendix-J	117(vi)	Dedicated Protection Equipment for 15 KVA E&M load to secure/protect UPS System from any disturbances of PS.			✓	(vi) Dedicated Protection Equipment (20 KVA Isolation Transformer) for 15 KVA E&M load to secure/protect UPS System from any disturbances of E&M Circuits as per the requirements of PS.
6	Volume-01	ITT Annexure-2	Appendix-J	118 (vi)	Dedicated Protection Equipment for 15 KVA E&M load to secure/protect UPS System from any disturbances of PS.			✓	(vi) Dedicated Protection Equipment (20 KVA Isolation Transformer) for 15 KVA E&M load to secure/protect UPS System from any disturbances of E&M Circuits as per the requirements of PS.
7	Volume-01	ITT Annexure-2	Appendix-J	119 (vi)	Dedicated Protection Equipment for 15 KVA E&M load to secure/protect UPS System from any disturbances of PS.			✓	(vi) Dedicated Protection Equipment (20 KVA Isolation Transformer) for 15 KVA E&M load to secure/protect UPS System from any disturbances of E&M Circuits as per the requirements of PS.
8	Volume-01	ITT Annexure-2	Appendix-J	134					
9	Volume-01	ITT Annexure-2	Appendix-J	117	2*400A 24-cell Battery Bank for 48V DC as per the requirements of PS.			✓	2*400AH 24-cell Battery Bank for 48V DC as per the requirements of PS.
10	Volume-01	ITT Annexure-2	Appendix-J	118	On-Line Redundant Modular UPS of 135 KVA each as per the requirements of PS with associated cubical of -			✓	On-Line Redundant Modular UPS of 135 KVA each as per the requirements of PS with associated cubical of -
11	Volume-01	ITT Annexure-2	Appendix-J	119	On-Line Redundant Modular UPS of 75 KVA each as per the requirements of PS with associated cubical of -			✓	On-Line Redundant Modular UPS of 75 KVA each as per the requirements of PS with associated cubical of -
	Volume-01	ITT Annexure-2	Appendix-J	71	On-Line Redundant Modular UPS of 45 KVA each as per the requirements of PS with associated cubical of -			✓	On-Line Redundant Modular UPS of 45 KVA each as per the requirements of PS with associated cubical of -
	Volume-01	ITT Annexure-2	Appendix-J	72	Double Sided platform Display Board/ Panel (True LED) for Elevated Stations as per the requirements of PS.			✓	Double Sided platform Display Board/ Panel (True colour LED) for Elevated Stations as per the requirements of PS.
	Volume-01	ITT Annexure-2	Appendix-J	73	Double Sided platform Display Board/ Panel (Direct view true LED) for Underground Stations as per the requirements of PS.			✓	Double Sided platform Display Board/ Panel (Direct-view true colour LED) for Underground Stations as per the requirements of PS.
	Volume-01	ITT Annexure-2	Appendix-J	74	Single Sided Concourse Display Board/Panel (Direct view true LED) for Elevated Stations as per the requirements of PS.			✓	Single Sided Concourse Display Board/Panel (Direct-view true colour LED) for Elevated Stations as per the requirements of PS.
	Volume-01	ITT Annexure-2	Appendix-J	74	Single Sided Concourse Display Board/Panel (Direct view true LED) for Underground stations as per the requirements of PS.				Single Sided Concourse Display Board/Panel (Direct-view true colour LED) for Underground stations as per the requirements of PS.

12	Volu me-01	Form Of Tender/ITT	Pg No 240	Key Dates	KD				During Peak of the Project (No.) at each location (Kanpur & Agra)
					Description	Priority Section Kanpur	Balance Section Kanpur	Priority Section Agra	
					KD 1	Submission of Preliminary Design	Within 16 Weeks from the date of LOA		
					KD 2	Submission of Final Design submission of all telecom sub-systems	48 weeks prior to KD6		
					KD 3	Obtain Consent of Employer's Engineer/Representative on Final Design	40 weeks prior to KD6		
					KD 4	Delivery of Equipment for Telecom Sub-systems at Tenderer's Premises in Kanpur and Agra respectively.	20 weeks prior to KD6		
					KD 5	Completion of Installation Test and Partial Acceptance Test	04 weeks prior to KD6		
					KD 6	Revenue Operation Date (ROD)	30.11.2021	02.09.2022	31.12.2023
					KD 7	Completion of Contract	31.12.2025		
					SN				
					1		Chief Project Manager	1	
					2		Dy. Project Manager	1	
					3		Technical System Manager	1	
					4		Design Manager	1	
					Annexure-3 Appendix A Project Organisation				
					ITT				
					Pg No 201/ITT				

	5	6	7	8	9	10	11	12	13	14	15					
	Quality Manager	Interface Manager	Installation Manager	T & C Manager	Design Engineer	System Engineer	Interface Engineer	Installation Engineer	T & C Engineer	Quality Engineer	Safety Managers/Staff					
	1	1	1	1	2	2	2	2	2	1	As per SHE manual					
4	Design Manager															
5	Quality Manager															
6	Interface Manager															
7	Installation Manager															
8	T & C Manager															
9	Design Engineer															
10	System Engineer															
11	Interface Engineer															
12	Installation Engineer															
13	T & C Engineer															
14	Quality Engineer															
15	Safety Managers/Staff															

- NOTES:
 (A) The following 4 Key Personnel shall be deployed within 30 days of Notice to Proceed (NTP) and shall be throughout the project at Project location: -
 1) Chief Project Manager- 1 No common for Kanpur and Agra.
 2) Dy CPM- 1 No at Kanpur + 1 No at Agra
 3) Design Manager- 1 No for both Kanpur & Agra
 4) Interface Manager- 1 No at Kanpur + 1 No at Agra

Remaining other positions shall be deployed 3 months before respective stages of the Kanpur and Agra projects.

Provisional Payment Against Material at Site:
 80% of cost centre related to manufacture, delivery i.e. cost centre C of all sections and cost centre B of MS section against indemnity bond as described in GCC. The balance 20% shall become payable for completion of installation and testing i.e. cost centre D for all sections and cost centre C of MS section.

Statutory Variation/Change in Taxes Duties:
 The Contract Price shall be adjusted for any new Tax if introduced after submission of bids on finished product during the contractual completion period, for which the contractor shall furnish documentary evidence in support of their claims. However, any increase in the cost due to Taxes or change in the existing taxes introduced during the extended contractual completion period due to the contractor's fault shall be to the contractor's account. The GST shall be reimbursable as per clause 35 of SCC.

13	Volu me- 02	SCC	39						Provisional Payment Against Material at Site: 80% of Cost Centre C of all sections (Except MS Section) and 80% of Cost Centre B for MS Section against indemnity bond as described in GCC. Balance 20% after acceptance of Installation Test as described in Cost centre D of all Sections (Except MS Section) and in Cost centre C of MS Section against safe custody Bank Guarantee. Safe Custody Bank Guarantee shall be released after acceptance of Installation Test.							
14	Volu me- 02	SCC	71						Additional Clause							

15	Volu-me-03	General Specification	Chapter 01	1.11.2	<p>Classification of Equipment Environment The locations at which equipment may be installed have been divided into two environmental classes as shown in Table 1-2. The classes of environment are considered to become more extreme from A to B.</p> <table border="1"> <thead> <tr> <th>S.N</th> <th>Class</th> <th>Location Of Equipment</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>A</td> <td>Air-Conditioned Offices, Computer and Equipment Rooms</td> </tr> <tr> <td>2</td> <td>B</td> <td>Ventilated Equipment Rooms in buildings at the surface or at the underground station or structures, Train Tunnels and Outdoors, Elevated Platform.</td> </tr> </tbody> </table> <p>The following are the minimum design requirements for equipment to be installed in each class of environment. Where any class does not have a value for a parameter the most extreme value quoted for the lesser class environments should be used.</p>	S.N	Class	Location Of Equipment	1	A	Air-Conditioned Offices, Computer and Equipment Rooms	2	B	Ventilated Equipment Rooms in buildings at the surface or at the underground station or structures, Train Tunnels and Outdoors, Elevated Platform.	<p>Classification of Equipment Environment The locations at which equipment may be installed have been divided into two environmental classes as shown in Table 1-2. The classes of environment are considered to become more extreme from A to B-C.</p> <table border="1"> <thead> <tr> <th>S.N</th> <th>Class</th> <th>Location Of Equipment</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>A</td> <td>Air-Conditioned Offices, Computer and Equipment Rooms</td> </tr> <tr> <td>2</td> <td>B</td> <td>Ventilated Equipment Rooms in buildings at the surface or at the underground station or structures, Train Tunnels and Outdoors, Elevated Platform.</td> </tr> <tr> <td>3</td> <td>C</td> <td>Viaduct and outdoor area</td> </tr> </tbody> </table> <p>The following are the minimum design requirements for equipment to be installed in each class of environment. Where any class does not have a value for a parameter the most extreme value quoted for the lesser class environments should be used.</p>	S.N	Class	Location Of Equipment	1	A	Air-Conditioned Offices, Computer and Equipment Rooms	2	B	Ventilated Equipment Rooms in buildings at the surface or at the underground station or structures, Train Tunnels and Outdoors, Elevated Platform.	3	C	Viaduct and outdoor area
S.N	Class	Location Of Equipment																									
1	A	Air-Conditioned Offices, Computer and Equipment Rooms																									
2	B	Ventilated Equipment Rooms in buildings at the surface or at the underground station or structures, Train Tunnels and Outdoors, Elevated Platform.																									
S.N	Class	Location Of Equipment																									
1	A	Air-Conditioned Offices, Computer and Equipment Rooms																									
2	B	Ventilated Equipment Rooms in buildings at the surface or at the underground station or structures, Train Tunnels and Outdoors, Elevated Platform.																									
3	C	Viaduct and outdoor area																									
16	Volu-me-03	General Specification	Chapter 01	1.11.4	<p>Ambient Temperature - 30oC-45oC</p> <p>Maximum Temperature - 60oC</p> <p>Relative Humidity - Nominal 70%, Maximum 100% (Non-Condensing)</p> <p>Air Quality - Polluted and dusty - SO2: 80-120mg/m3</p> <p>Electrical Noise - Impulse 1kV/5KV, 1.2/50 rise/decay, 500 Ohm source impedance, 0.5 J source energy.</p> <p>Radio & High frequency as Class A.</p>	<p>Ambient Temperature 30 Degree C</p> <p>Maximum Temperature - 45 Degree C</p> <p>Relative Humidity - Nominal 70%, Maximum 100% (Non-Condensing)</p> <p>Air Quality - Polluted and dusty - SO2: 80-120mg/m3</p> <p>Suspended Particulate Matter: 360-540mg/m3</p> <p>Electrical Noise - Impulse 1kV/5KV, 1.2/50 rise/decay, 500 Ohm source impedance, 0.5 J source energy.</p> <p>Radio & High frequency as Class A.</p> <p>Requirements of Class C Ambient Temperature- 46oC Maximum Temperature- 60oC Electrical Noise- Impulse 5KV otherwise as Class B</p>																					
17	Volu-me-04	Particular Specifications	Pg No 28/Chapter 01	3.8	<p>The KNPAGS-01 Contractor shall be provided space of approximately 1500 SQM to set up Project Office and Storage Space. KNPAGS-01 contractor shall be required to set up station at this Project Office and Site Office throughout the contract period. The key personnel for Project management, Procurement, Design, Implementation, Site co-ordination, Interface, Quality & Assurance, Testing and commissioning, maintenance etc, and shall submit a list for the same to review.</p> <p>The Contractor will be provided a space of required size at suitable place to set up its Site office. The seat arrangement for Employer representative or Engineer representative shall be reserved as minimum 8 persons in site office.</p> <p>The Contractor shall be responsible for the erection of project offices and site offices. The Contractor shall arrange for the utilities and any facilities and resources necessary to operate the site.</p> <p>The Contractor shall be responsible for all costs of running the project offices, site offices, including but not limited to, utilities, consumables, office supplies, cleaning and maintenance. The contract shall be responsible for arrangement of drinking water for all</p>	<p>The KNPAGS-01 Contractor shall be provided space of approximately 4500 500 SQM at suitable location to set up Project Office and Storage Space. KNPAGS-01 contractor shall be required to set up project office at project location and site office at site location and necessarily have to station at this Project Office and Site Office throughout the contract period. The key personnel for Project management, Procurement, Design, Implementation, Site co-ordination, Interface, Quality & Assurance, Testing and commissioning, maintenance etc, and shall submit a list for the same to review.</p> <p>The Contractor will be provided a space of required size at suitable place to set up its Site office. The seat arrangement for Employer representative or Engineer representative shall be reserved as minimum 8 persons in site office.</p> <p>The Contractor shall be responsible for the erection of project offices and site offices. The Contractor shall arrange for the utilities and any facilities and resources necessary to operate the site.</p> <p>The Contractor shall be responsible for all costs of running the project offices, site offices, including but not limited to, utilities, consumables, office supplies, cleaning and maintenance. The contract shall be responsible for arrangement of drinking water, water.</p>																					

30	Volu me-04	Particular Specification	Chapt 04	3.3.4	The Contractor shall liaise with all concerned authorities including DoT, WPC, SACFA, civil Aviation authorities and other local authorities and obtain necessary clearances / sanctions for installation and commissioning of the Radio system. All costs therein have to be borne by the Contractor.							The Contractor shall liaise with all concerned authorities including DoT, WPC, SACFA, civil Aviation authorities and other local authorities and obtain necessary clearances / sanctions for installation and commissioning of the Radio system. All costs, except Regulatory Fees, thereon have to be borne by the Contractor.
31	Volu me-01	ITT Annexure-2	Appendix J	148	Local level Access Controllers with enclosures & Power Supply units and along with all required accessories for stations, depots, admin buildings, OCC, RSSs, etc as per the Min. BoQ Qty-36 for Kanpur & 36 for Agra.							Local level Access Controllers with enclosures & Power Supply units and along with all required accessories for stations, depots, admin buildings, OCC, RSSs, etc as per the Min. BoQ Qty-36 for Kanpur & 36 for Agra.
32	Volu me-04	Particular Specification	Chapt 02	1.10.1.5	Each FOTIS Network Management workstation shall be connected with the common colour laser network printer work server, and associated printer for alarm and event printout. The minimum specification of colour laser network printer is as follows: - <ul style="list-style-type: none"> • Produce up to 60 full-colour page per minute (ppm) • Add professional finishing and captivating colour in-house • Expedite print tasks with automated workflows and shortcuts • Print and share information via your personal mobile device • Produce more types of documents on a wider range of media • Minimise energy costs with a host of eco-friendly capabilities • Intuitive 25.65 cm Smart Operation Panel • USB/SD Card Slot • Web Browser • Automatic Duplexing • Internal Multi-fold Unit • 3,000-Sheet Finisher • Paper Trays and 100-Sheet Bypass Tray • Paper Feed Units • Large Capacity Trays 							The Minimum Specification of colour laser network printer is provided in Appendix-F of Chapter-11 of PS.
32	Volu me-04	Particular Specification	Chapt 06	6.3.4.5	The Contractor shall provide a PIDS management system for the overall control, supervision, maintenance and configuration of the entire PIDS. It is envisaged that one NMS and a corresponding workstation shall be provided at both locations of OCC and BCC. The NMS at OCC and BCC shall have jurisdiction over whole Phase-1A stations. The NMS should not be available for access in other than CSS/CER. The PAS & PIDS NMS shall be on the same server and workstation.							The Contractor shall provide a PIDS management system for the overall control, supervision, maintenance and configuration of the entire PIDS. It is envisaged that one NMS and a corresponding workstation shall be provided at both locations of OCC and BCC. The NMS at OCC and BCC shall have jurisdiction over whole Phase-1A stations. The NMS should not be available for access in other than CSS/CER. The PAS & PIDS NMS shall be on the same server and workstation.
33	Volu me-04	Particular Specification	Chapt 09	1.1.3	This specification describes the electrical, mechanical characteristics and requirements of three phases, on-line, double conversion, Modular Hot Swappable Uninterruptible Power Supply (UPS). The UPS should be having VFI (Voltage Frequency Independent) technology, fully DSP controlled power factor corrected rectifier and IGBT inverter capable of providing high quality AC power for sensitive electronic equipment loads.							This specification describes the electrical, mechanical characteristics and requirements of three phases, on-line, double conversion, Modular Hot Swappable Uninterruptible Power Supply (UPS). The UPS should be having VFI (Voltage Frequency Independent) technology, fully DSP controlled power factor corrected rectifier and IGBT inverter capable of providing high quality AC power for sensitive electronic equipment loads.
34	Volu me-04	Particular Specification	Chapt 09	2.1.3	Equipment shall be designed and manufactured in modular manner to facilitate the fault diagnosis and replacement of each modular part. Each module shall be capable of being interchanged with other modules of the same type without affecting the rest of modules in place. Power Module of suitable rating with unity power Factor & Hot Swappable STS Module, Controller & Aux Power Board.							Equipment shall be designed and manufactured in modular manner to facilitate the fault diagnosis and replacement of each modular part. Each module shall be capable of being interchanged with other modules of the same type without affecting the rest of modules in place. Power Module of suitable rating with unity power Factor & Hot Swappable STS Module, Controller & Aux Power Board.
35	Volu me-04	Particular Specification	Chapt 09	2.1.6	UPS should be configurable for Energy Recycle Mode that enables testing of the unit for load testing without external load to test & verify the UPS							UPS should be configurable for Energy Recycle Mode that enables testing of the unit for load testing without external load to test & verify the UPS
36	Volu me-04	Particular Specification	Chapt 09	2.2.5	Redundant System with redundant controller, Dual Aux Power Supply.							Redundant System with redundant controller, Dual Aux Power Supply.
37	Volu me-04	Particular Specification	Chapt 09	2.2.6	Dual CAN Bus within frame & redundant CAN Bus between parallel systems to enable UPS parallel communication redundancy to be removed or inserted UPS in parallel configuration without need of transferring it to bypass mode.							Dual CAN Bus within frame & redundant CAN Bus between parallel systems to enable UPS parallel communication redundancy to be removed or inserted UPS in parallel configuration without need of transferring it to bypass mode.
38	Volu me-04	Particular Specification	Chapt 09	2.2.7	UPS is configured for Green Mode to enable automatically transferring some modules to sleep mode in case of applied load is less than certain load percentage.							UPS is configured for Green Mode to enable automatically transferring some modules to sleep mode in case of applied load is less than certain load percentage.

39	Volu me-04	Particular Specification	Chapt 09	3.1.3	The Hot swappable modular UPS with maximum of 6 modules vertically and 8 frames horizontally. Battery backup system for S&T/C and Telecommunication system shall include 2 numbers 3-phase Output, N, PE (TN-S) UPS in online redundant configuration powered by Two separate Battery Banks (one for each UPS at each station and Depot, a stand by spare cell charger for 1to 6 UPS cells) and a spare cell bank with 6 numbers cells	✓	The Hot swappable modular UPS with maximum of 6 modules vertically and 8 frames horizontally. Battery backup system for S&T/C and Telecommunication system shall include 2 numbers 3-phase Output, N, PE (TN-S) UPS in online redundant configuration powered by Two separate Battery Banks (one for each UPS at each station and Depot, a stand by spare cell charger for 1to 6 UPS cells) and a spare cell bank with 6 numbers cells
40	Volu me-04	Particular Specification	Chapt 09	3.1.4	The transformer insulation class shall be in accordance with heat they are likely to generate but in no case the insulation Class shall be worse than Class B insulation. The Contractor shall submit detailed calculations to substantiate his design.	✓	The transformer insulation class shall be in accordance with heat they are likely to generate but in no case the insulation Class shall be worse than Class B insulation. The Contractor shall submit detailed calculations to substantiate his design.
41	Volu me-04	Particular Specification	Chapt 09	3.2.7.2 (j)	Dual CAN Bus redundancy to enable UPS to be removed or inserted UPS in parallel configuration without need of transferring it to bypass mode.	✓	Dual CAN Bus redundancy to enable UPS to be removed or inserted UPS in parallel configuration without need of transferring it to bypass mode.
42	Volu me-04	Particular Specification	Chapt 09	3.2.9 (14)	(14) Efficiency (AC-AC) of complete system (including input and output transformers): Better than 90% (From 25% load to full load)	✓	(14) Efficiency (AC-AC) of complete system (including input and output transformers) Better than 90% 80% (From 25% load to full load)
43	Volu me-04	Particular Specification	Chapt 09	3.2.9 (15)	Inverter efficiency (including output transformer) Better than 0.95	✓	Inverter efficiency (including output transformer) Better than 0.95 0.93
44	Volu me-04	Particular Specification	Chapt 09	3.2.11	Mode selection: online Mode, Green Mode, ECO Mode, Energy Recycle Mode & Frequency conversion mode	✓	Mode selection: online Mode, Green Mode, ECO Mode, Energy Recycle Mode & Frequency conversion mode
45	Volu me-04	Particular Specification	Chapt 09	3.2.12	The UPS system shall have at least the following LED 10" displays:	✓	The UPS system shall have at least the following LED 10" displays:
46	Volu me-04	Particular Specification	Chapt 09	3.2.12	Temperature: STS/Inverter/PEC	✓	Temperature: STS/Inverter/PEC
47	Volu me-04	Particular Specification	Chapt 09	4	The UPS system shall be designed and equipped with all necessary hardware, software and capacity for future 25% additional load. Modular UPS Frame must have the provision to add required power modules to cater 25% spare capacity.	✓	The UPS system shall be designed and equipped with all necessary hardware, software and capacity for future 25% additional load. Modular UPS Frame must have the provision to add required power modules to cater 25% spare capacity.
48	Volu me-04	Particular Specification	Chapt 04	4.4.2	The service life of the CDRS equipment except server/Workstation shall not be less than 15 years. The service life of all types of cables shall not be less than 25 years. The service life of Server/Workstation shall not be less than 10 years. Service life shall be counted from the commencement date of Revenue Operation Date (ROD).	✓	The service life of the CDRS equipment except server/Workstation shall not be less than 15 years. The service life of all types of cables shall not be less than 25 years. The service life of Server/Workstation shall not be less than 10 years. Service life shall be counted from the commencement date of Revenue Operation Date (ROD).
49	Volu me-04	Particular Specification	Chapter-08	1 of A. Display unit of Annexure-1	4K Laser based Large Video Screen Wall Cubes of 70" Diagonal 3 (C) X 2 (R) configuration with Complete equipment along with Base Stand and other accessories.	✓	4-2K Laser based Large Video Screen Wall Cubes of 70" Diagonal 3 (C) X 2 (R) configuration with Complete equipment along with Base Stand and other accessories.
50	Volu me-04	Particular Specification	Chapter-08	3 of A. Display unit of Annexure-1	The Rear Projection Modules must be based on Single Chip DLP (Digital Light Processing), Ultra HD Native, and Rear Projection technology.	✓	The Rear Projection Modules must be based on Single Chip DLP (Digital Light Processing), Ultra Full HD Native, and Rear Projection technology.
51	Volu me-04	Particular Specification	Chapter-08	4 of A. Display unit of Annexure-1	The DMD (Digital mirror device) chip should have minimum 8 Mega pixels and the DMD mirrors should be square in shape.	✓	The DMD (Digital mirror device) chip should have minimum 8 2 Mega pixels and the DMD mirrors should be square in shape.
52	Volu me-04	Particular Specification	Chapter-08	6 of A. Display unit of Annexure-1	The overall resolution of the full graphics wall shall be minimum 11,520 x 4,320 pixels.	✓	The overall resolution of the full graphics wall shall be minimum 44-520 x 4-320 5,760 x 2,160 pixels.
53	Volu me-04	Particular Specification	Chapter-08	7 of A. Display unit of Annexure-1	The Minimum Diagonal Size of each Visual Display Unit / Rear Projection Module should be 70" nominal with a native resolution of 3840 x 2160 4K Ultra HD and should offer 16.7 million colours.	✓	The Minimum Diagonal Size of each Visual Display Unit / Rear Projection Module should be 70" nominal with a native resolution of 3840 x 2160 4K Ultra HD and should offer 16.7 million colours.

54	Volu-me-04	Particular Specification	Chapter-08	12 of A. Display unit of Annexure-1				
55	Volu-me-04	Particular Specification	Chapter-08	1 of B. Display				<p>The brightness of each projection engine shall be minimum 2200 lumens (Typically). The luminance on each rear projection module (display) shall be 450 nits (cd/m²) or higher.</p> <p>The Controller should have BIS certification. The Controller should be in an industrial 19" rack mounted casing based on server architecture having processor Intel Xeon i7, 3.0 Ghz or better. Please refer Appendix-F of Chapter-11 of PS for server specification.</p>
56	Volu-me-04	Particular Specification	Chapter-08	12 of B. Display				<p>There should be possibility of connecting minimum 40 Streaming Video Inputs of 2 MP (3072x1728) cameras with H.264, H.265 compression mode from different IP based Surveillance Cameras installed at stations/deposits to this controller to show the multiple Streams sources in scalable and moveable windows on the graphics wall.</p>
57	Volu-me-04	Particular Specification	Appendix-J. Minimum BoQ	97				<p>4K Projection Display System complete with all controllers, softwares and associated accessories for Security Control Rooms (Large Video wall 3x2x70") as per the requirements of PS.</p>
58	Volu-me-02	SCC	Pg 18	35				<p>(e) Tenderers shall submit an undertaking that neither they nor their sub-contractors / sub-vendors shall avail the deemed export benefit as the same shall be availed directly by UPMRC and retained</p> <p>(e) The bidder shall be eligible for availing concessional duty benefits under Chapter 98.01 of Customs Tariff Act for Project Imports. After award of contract, at the written request of the Contractor, UPMRCL can facilitate the contractor with sponsoring/recommendation Letter for getting themselves registered for availing Project Import Benefits. The contractor shall also ensure completion of all formalities including closure of Project Import etc., if any, with the custom authorities in terms of the Regulations.</p> <p>(f) In case deemed export benefits are available, at any stage during execution of the contract, the contractor shall be required to avail the same and pass on the benefits to UPMRCL. For availing the said benefits, necessary documents in accordance with the laws of the land and extant policies of the Government of India shall be followed by the contractor and in such case, prices will be adjusted and paid accordingly</p>

ANNEXURE-3

APPENDIX A – PROJECT ORGANISATION
 [Refer Paragraph A10. (a)]
MINIMUM KEY STAFF REQUIREMENT

S. No.	Designation	Throughout the Project at Kanpur	Throughout the Project at Agra	During Peak of the Project (No.) at each location (Kanpur & Agra)
1	Chief Project Manager	1		--
2	Dy. Chief Project Manager	1		--
3	Technical System Manager	1	1	
4	Design Manager		1	--
5	Quality Manager	1	1	1
6	Interface Manager	1	1	--
7	Installation Manager	1	1	1
8	Testing & Commissioning Manager	1	1	1
9	Design Engineer	2	2	2
10	System Engineer	2	2	2
11	Interface Engineer	2	2	2
12	Installation Engineer	2	2	2
13	Testing & Commissioning Engineer	2	2	2
14	Quality Engineer	1	1	1
15	Safety managers/staff		AS PER SHE MANUAL	1

NOTES:

- (A) The following 4 Key Personnel shall be deployed within 30 days of Notice to Proceed (NTP) and shall be throughout the project at Project location: -
- 1) Chief Project Manager- 1 No common for Kanpur and Agra.
 - 2) Dy CPM- 1 No at Kanpur + 1 No at Agra
 - 3) Design Manager- 1 No for both Kanpur & Agra
 - 4) Interface Manager- 1 No at Kanpur + 1 No at Agra
- Remaining other positions shall be deployed 3 months before respective stages of the Kanpur and Agra projects.

1. Chief Project Manager – B. Tech/M.Tech in Electrical or Electronics Engineering having minimum 15 years of total experience out of which 5 years should be in projects of similar nature. Also he shall have minimum experience of one Metro PM/Dy. PM for min 5 years.
2. Dy. Chief Project Manager – B. Tech/M.Tech in Electrical or Electronics Engineering having minimum 12 years of total experience out of which 4 years should be in projects of similar nature. Also he shall have minimum experience of one Metro

3. Appendix C - Information regarding Performance of the offered equipment elsewhere
 [Refer Paragraph A10. (c)]

S.No.	Equipment	Architecture (Specified in PS)	Model No. / Trade Name	Details of Railway Authority	Locations where proposed Equipment is in use on either Passenger Carrying Railways in Monorail/ Large Infrastructure Project/Airport	Quantity of Equipment in use	Date of Commissioning	User Acceptance Certificate attached (Y / N)	Performance Data
A1	Gigabit Routers and Layer-03 Switches								
A2	Industrial Grade Layer-02 Switches								
A3	Optic Fibre Cable								
A4	IP Network Security System								
A5	T-SCADA system and Software								
A6	288 Core Fiber Management System								
A7	Core Switch as per PS								
A8	Non-POE Layer-2 Switches as per PS								
A9	PoE Layer-2 Switches as per PS								
B1	Leaky Coaxial Cable								

FORM OF TENDER: Appendix-01: Contract Conditions

REQUIREMENT UNDER GENERAL CONDITIONS OF CONTRACT (GCC)

1	Amount of Performance Security (GCC: Sub-Clause 4.2.1)	10% of the Contract Price in types and proportions of currencies in which the Contract Price is Payable
2	Latest date for commencement of the Works. (GCC Sub-Clause 8.1) "Time for completion" of the work from the date of commencement of the work (Clause 8.2 of the GCC)	Date given in the Employer's Notice to Proceed/LOA 40-36 months
3	Liquidated Damages (Clause 8.2 of the GCC)	As per GCC Clause 8.5
4	Defects Liability Period for whole of the works (Clause 10 of the GCC)	As per clause 32 & 33 of SCC after the date of issue of Taking-Over Certificate for whole of the works
5	Amount of advance payment (GCC Sub-Clause 11.2 & SCC 37)	An amount equivalent to 10 % of the contract value. The distribution of this advance in different foreign currencies will be in the same proportion in which the foreign currency portion of the fixed Lump Sum Price has been quoted.
6A	Amount of Professional Indemnity Insurance. (GCC Sub-Clause 15.1 & 15.5 of the GCC)	5% of the contract lump sum price
6B	Insurance cover for Tenderer's All Risk and other requirements as specified in the GCC (Clause 15 of the GCC)	100% of the Total Contract Price.
7	Amount of Third-Party Insurance (GCC Sub-Clause 15.3 & 5.8) Period in which all insurances have to be submitted (GCC Sub-clause 15.5)	INR 0.5 Million for any one incident with number of incidents unlimited. The insurance will be effective within 4 weeks from the date of commencement of works.
8	Stages and Key Dates	See Next Pages.
9	Tenderer's Name and Address. (GCC Clause 18)	(Tenderer to complete)
10	Employer's Name and Address	Uttar Pradesh Metro Rail Corporation, Administrative Building, Vipin Khanda Gomti Nagar, Lucknow-226010

Fare Collection System, Signalling, Mobile Operators etc. This shall also include the commissioning of required telecom subsystems at respective OCC/CERS.

1.6 STAGE 6 – Key Date 6 (KD6): Achievement of Revenue Operations.

1.7 STAGE 7 – Key Date 7 (KD7): Completion of Contract
 Achievement: Centralized OCC at Lucknow for Kanpur and Agra Corridors, Delivery of Contract Spares, Delivery of Special Tools & Test Equipment, Delivery of as Built Drawings, and Operation & Maintenance Manuals, Completion of Operation & Maintenance Training and Completion of DLP requirement to the satisfaction of Employer's Representative, Issue of Performance Certificate in accordance with GCC/SCC. Completion of Period of Supervision of Maintenance.

Schedule of Key Dates

Key Date	Description	Priority	Balance	Section Agra	Section Agra
		Kanpur	Kanpur		
		(i) IM Section	(i) CT Section	(i) TF Section	(i) MR Section
		(ii) OCC	(ii) BN Section	(ii) OCC	(ii) IS Section
		(iii) Polytechnic Depot	(iii) AD Section	(iii) PAC Depot	
		(iv) VB Section	(iv) VB Section	(iv) TJ Section	
		(v) Agriculture University Depot			

KD1	Submission of Preliminary Design	Within 16-04 Weeks from the date of LOA (Letter of Acceptance)
-----	----------------------------------	--

KD2	Submission of Final Design submission of all telecom sub-systems	48 39 Weeks prior to KD6
-----	--	--------------------------

KD3	Obtain Consent of Employer's Representative on Final Design	49 35 Weeks prior to KD6
-----	---	--------------------------

KD4	Delivery of Equipment for Telecom Sub-Systems at Tenderers	20 Weeks prior to KD6
-----	--	-----------------------

Sub Total												
70	PAS/PIDS Integrated Workstations (non redundant) including Mic and accessories for underground, elevated/at grade stations, OCC, Depots, CERS etc. as per the requirements of PS.	Sets	36	18	54							
71	Double Sided platform Display Board/ Panel (True colour LED) for Elevated Stations as per the requirements of PS.	Nos.	36	12	48							
72	Double Sided platform Display Board/ Panel (Direct view true colour LED) for Underground Stations as per the requirements of PS.	Nos.	24	14	38							
73	Single Sided Concourse Display Board/Panel (Direct view true colour LED) for Elevated Stations as per the requirements of PS.	Nos.	36	12	48							
74	Single Sided Concourse Display Board/Panel (Direct view true colour LED) for Underground stations as per the requirements of PS.	Nos.	24	14	38							
75	PIDS Power Cable (armoured) Fire Retardant type with low smoke/zero halogen in Underground section and Low smoke/low halogen in elevated/at-grade section as per the requirements of PS.	Kms	9	4	13							
76	PIDS Data Cable (armoured) Fire Retardant type with low smoke/zero halogen in full Underground section and Low smoke/low halogen in elevated/at-grade section as per the requirements of PS.	Kms	4	2	6							
77	Any Other Item necessary for meeting fully the Contract Requirements as per the requirements of PS.	LS	LS	LS	LS							

114	ODF 24 Ports (for outside TER Switch) as per the requirements of particular specifications.	Nos.	120	54	174														
115	Miscellaneous Items to meet the fully requirements as per PS.	LS	LS	LS	LS														
Sub Total																			
Chapter-9 : PSS (Power Supply System)																			
117	On-Line Redundant Modular UPS of 135 KVA each as per the requirements of associated cubicals of - (i) PDU, ATS and Input Isolation Transformer, etc as per the requirements of PS. (ii) Servo Controlled Voltage Stabiliser (SCVS) as per the requirements of PS. (iii) Output Isolation Transformer(it may be the integral part of UPS) as per the requirements of PS. (iv) ACDB cubicals along with Battery Breaker as per the requirements of PS. (v) Battery Management System as per the requirements of PS. (vi) Dedicated Protection Equipment (20 KVA Isolation Transformer) for 15 KVA E&M load to secure/protect UPS System from any disturbances of E&M Circuits as per the requirements of PS.	Sets	2	1	3														
118	On-Line Redundant Modular UPS of 75 KVA each as per the requirements of PS with associated cubicals of - (i) PDU, ATS and Input Isolation Transformer, etc as per the requirements of PS. (ii) Servo Controlled Voltage Stabiliser (SCVS) as per the requirements of PS. (iii) Output Isolation Transformer(it may be the integral part of UPS) as per the requirements of PS. (iv) ACDB cubicals along with Battery Breaker as per the requirements of PS. (v) Battery Management System as per the requirements of PS. (vi) Dedicated Protection Equipment (20 KVA Isolation Transformer) for 15 KVA E&M load to secure/protect UPS System from any disturbances of E&M Circuits as per the requirements of PS.	Sets	9	6	15														

144	Management, Configuration, Management System for Visitor	Nos.	2	1	3														
145	Software for CERS as per requirement of PS. Hardware for writing & printing system of access control contactless smart cards for operational and security requirements of UPMRC as per PS.	Nos.	2	2	4														
146	NMS Server alongwith Workstation (HMI) for Fault Configuration, Alarm, Provision & Security (FCAPS) management of Access Control System (ACS) and printer at CERS of Kanpur Metro rail Premises as per requirements of PS.	Nos.	2	2	4														
147	Visitor Management System with workstations (HMI), printers, cameras, etc alongwith all necessary accessories for operational and security requirements at depots as per requirements of PS.	Nos.	2	1	3														
148	Local level Access Controllers with enclosures & Power Supply units and alongwith all required accessories for stations, depots, admin buildings, OCC, RSSS, etc as per the requirements of PS.	Nos.	36	-36-18	72														
149	Door Interface Controllers with enclosures & Power Supply units and alongwith all required accessories for stations, depots, admin buildings, OCC, RSSS, etc as per requirements of PS.	Nos.	356	174	530														

- (b) Parent company Undertakings in accordance with Clause 4.2 of the GCC;
- (e) Parent company Guarantees in accordance with Clause 4.2 of the GCC;

C19.2 The Tenderer shall submit other warranties and guarantees in accordance with GCC and SCC clauses.

C19.3 If the Tenderer comprises a partnership, consortium or joint venture, a parent company of each member or participant will be required to execute the Undertakings and Guarantees referred to in sub-paragraphs (b) and (c) of **C19.1** above.

C19.4 Forms of the above documents are given in the Schedules to the Special Conditions of Contract.

C19.5 The Tenderer should note that all Guarantees, Undertakings and Warranties except Advance Payment Guarantee shall be executed prior to signing of the Contract.

C20 Labour

The Tenderer's attention is especially drawn to Clause 6 of the GCC and Clause 23 of SCC in relation to the responsibility of the Tenderer for obtaining an adequate supply of labour, their Rates, Wages and Conditions.

Tenderer shall ensure compliance to Labour Laws as specified in Conditions of Contract on Safety Health and Environment.

Tenderers are required to note that the minimum qualification required for labourers shall be as per labour laws of Central and state government.

C21 Other Tenderers

The Tenderer's attention is drawn to the requirement that access to the Site or parts of the Site will, from time to time, have to be shared with other tenderers carrying out works on, or in the vicinity of the Site including, without limitation, works relating to:

Design and Construction of Civil works

Design, Manufacture and Installation of Rolling Stock, Signalling and Train Control System

Design, Manufacture and Installation of Lifts and Escalators

Design, Manufacture and Installation of Track work;

Design, Manufacture and Installation of Automatic Fare Collection

Design, Manufacture and Installation of Traction Works

Any other tenderer concerned for this work

3. Appendix C - Information regarding Performance of the offered equipment elsewhere
 [Refer Paragraph A10. (c)]

S.No.	Equipment	Architecture (Specified in PS)	Model No. / Trade Name	Details-of-Railway Authority	Locations where proposed Equipment is in use on other-Passenger-Carrying railways-in Railways/Metro/LRT/ Monorail/ Large Infrastructure Project/Airport	Quantity of Equipment in use	Date of Commissioning	User Acceptance Certificate attached (Y / N)	Performance Data
A1	Gigabit Routers and Layer-03 Switches								
A2	Industrial Grade Layer-02 Switches								
A3	Optic Fibre Cable								
A4	IP Network Security System								
A5	T-SCADA system and Software								
A6	288 Core Fiber Management System								
A7	Core Switch as per PS								
A8	Non-POE Layer-2 Switches as per PS								
A9	PoE Layer-2 Switches as per PS								
B1	Leaky Coaxial Cable								

Date & time of Submission of Tender	26-10-2020 09.11.2020 up to 15:00 Hrs.
Date & time of opening of Tender	26-10-2020 09.11.2020 @ 15:30 Hrs.
Authority and place for purchase of tender documents, seeking of clarifications and submission of completed tender documents	<p>CEE/Projects-II Uttar Pradesh Metro Rail Corporation, Administrative Building, Vipin Khand, Gomti Nagar Lucknow-226010 Email: loveleenkumar.cee@gmail.com</p>

1.1.3 Source of Funds:

UPMRCL has applied Loans from multilateral funding agency (EIB) hereinafter-called "Funding Agency" towards the part cost of the Project, and intends to apply a portion of the proceeds of the loans to payments under this contract. Disbursement of the loans will be subject, in all respects, to the terms and conditions of the Loan Agreements, including the disbursement procedures and the applicable procurement guidelines of EIB. EIB has already agreed in principle for financing the Kanpur project requirements included in the tender. For Agra project, UPMRCL has already applied for funds for requirements included in this tender. However, in case the funding of agra project is not agreed by EIB then UPMRCL will fund from its internal resources. ([http://www.eib.org/attachments/strategies/guide to procurement en.pdf](http://www.eib.org/attachments/strategies/guide%20to%20procurement%20en.pdf)).

1.1.4 Initial Filter Criteria:

1.1.4.1 Eligible Applicants:

- i) A Tenderer may be from any country and all areas either a single entity or a combination of entities in the form of a joint venture or consortium under an existing agreement. In the case of a JV/Consortium: all partners shall be jointly and severally liable for the execution of the Contract in accordance with the Contract terms; and the JV/Consortium shall nominate a Representative who shall have the authority to conduct all business for and on behalf of any and all the partners of the JV/ Consortium during the tendering process and, in the event the JV/Consortium is awarded the Contract, during contract execution.
- ii) A Tenderer, and all partners constituting the Tenderer, shall be from any country and all areas.
- iii) A Tenderer and all partners constituting the Tenderer, shall not have a conflict of interest. All Tenderers found to have a conflict of interest shall be disqualified. A Tenderer may be considered to have a conflict of interest with one or more parties in this tendering process, if:
 - a) Tenderer and all partners constituting the Tenderer has been engaged by the Employer to provide consulting services for the preparation related to procurement for or implementation of the project;
 - b) Tenderer and all partners constituting the Tenderer is any associates/affiliates (inclusive of parent firms) mentioned in subparagraph (a) above; or

38	Clause 11.2.2	Advance against Plant and Machinery No advance shall be paid against Plant and Machinery by the employer.
38.a	Clause 11.2.5	Interest in case of delay in repayment of advances Should there be any delay in progress and completion of work, as a result of which it is not possible to recover the advance and interest thereon, before the original date of completion stipulated in the contract, then the interest to be charged from the contractor on the remaining portion of advance beyond the completion date specified in the contract, shall be 2% above State Bank of India prime lending Rate or 10% whichever is higher.
39	Clause 11.3	Provisional Payment Against Material at Site 80% of Cost Center C of all sections (Except MS Section) and 80% of Cost Center B for MS Section against Indemnity bond as described in GCC. Balance 20% after acceptance of Installation Test as described in Cost center D of all Sections (Except MS Section) and in Cost center C of MS Section against safe custody Bank Guarantee. Safe Custody Bank Guarantee shall be released after acceptance of Installation Test. 80% of cost centre related to manufacture, delivery i.e. cost centre C of all sections and cost centre B of MS section against indemnity bond as described in GCC. The balance 20% shall become payable for completion of installation and testing i.e. cost centre D for all sections and cost centre C of MS section.
40	Clause 11.4.1	Application for Interim Payment Certificate Contractor may apply for part completion of any milestone, if the milestone activity has been at least 50% completed, along with supporting details justifying the percentage completion being requested. The Employer's Engineer shall have the full authority to accept, modify or reject any such request. The decision of the Engineer shall be final and binding. Notwithstanding early completion of the Milestones or part of milestones, the payment to the Contractor at any time shall not exceed the cumulative monthly cash flows agreed at the time of award of the Contract.
41	Clause 11.4.2	Not applicable on this Contract
42	Clause 11.6.1	Payment Following is added in the GCC Clause 11.6.1 If and to the extent that the Pricing Document expressly specifies in relation to a Cost Centre that the Contractor is entitled to payment in a currency other than Indian Rupees, or the Engineer makes a determination of Cost in a currency other than Indian Rupees, all such payments shall be made in the relevant foreign currency and no adjustment shall be made to any payment or to the Final Contract Sum on account of any fluctuation in the exchange rate between Indian Rupees and such other currency from the Base Date. All payments in a foreign currency shall be made against an irrevocable

71	Additional Clause	Statuary Variation/Change in Taxes Duties: The Contract Price shall be adjusted for any new Tax if introduced after submission of bids on finished product during the contractual completion period, for which the contractor shall furnish documentary evidence in support of their claims. However, any increase in the cost due to Taxes or change in the existing taxes introduced during the extended contractual completion period due to the contractor's fault shall be to the contractor's account. The GST shall be reimbursable as per clause 35 of SCC.
-----------	--------------------------	---

SPECIAL CONDITIONS OF CONTRACT

- (3) The Contractor's attention is drawn to the more severe environmental conditions that may exist during the construction period and shall take adequate measures to protect the Permanent Works against any deleterious effects of such conditions during the time between installation and final completion of the Project.
- (4) Air throughout the Project will contain considerable moisture content and the atmosphere will be corrosive. The Permanent Works shall be tropicalised and vermin proof.
- (5) The information on climatic conditions in Kanpur and Agra is indicative and the Contractor should familiarise himself with all aspects of meteorological conditions.

1.11.2 Classification of Equipment Environment

The locations at which equipment may be installed have been divided into ~~two~~ three environmental classes as shown in Table 1-2. The classes of environment are considered to become more extreme from A to B-C.

CLASS	LOCATION of EQUIPMENT
A	Air Conditioned Offices, Computer and Equipment Rooms
B	Ventilated Equipment Rooms in buildings at the surface or at the underground station or structures, Train Tunnels and Outdoors Elevated Platform.
C	Viaduct and outdoor area

Table 1-2 Classes of Environment

The following are the minimum design requirements for equipment to be installed in each class of environment. Where any class does not have a value for a parameter the most extreme value quoted for the lesser class environments should be used.

1.11.3 Requirements for Class A

Minimum Temperature -	5°C
Ambient Temperature	25°C
Maximum Temperature -	35°C
Relative Humidity -	Minimum 0%, Nominal 65%, Maximum 95% (Non Condensing)
Electrical Noise -	High Frequency to 1MHz, 1kV damped to 50% after 6 cycles. Radio Frequency field strength 10 V/m, UHF & VHF bands.

1.11.4 Requirements for Class B

Ambient Temperature -	30°C-46°C 30 Degree C
Maximum Temperature -	60°C-45 Degree C

Relative Humidity	Nominal 70%, Maximum 100% (Non Condensing)
Air Quality -	Polluted and dusty - SO ₂ : 80-120mg/m ³
Electrical Noise -	Suspended Particulate Matter: 360-540mg/ m ³ Impulse 1kV/5KV, 1.2/50 rise/decay, 500 Ohm source impedance, 0.5 J source energy. Radio & High frequency as Class A.

Requirements of Class C

Ambient Temperature- 46oC

Maximum Temperature- 60oC

Electrical Noise- Impulse 5KV otherwise as Class B

All equipment shall be designed and tested in accordance with the given figured allowing a margin of at least 10% greater and 2°C less than the limits recorded. All designs for equipment shall work within the enclosures proposed with the specified environment outside the enclosure

1.11.5 Electromagnetic Compatibility (EMC)

Electronic equipment in a railway environment shall be immunised against the usual electromagnetic influences to be expected from the rail operations. For this, the following EMC classification in accordance to IEC 801 or similar, for the equipment rooms shall be achieved:

1.11.5.1 Electrostatic discharge

The electronic equipment rooms shall be designed in accordance to class 2 of IEC 801-2 or similar.

1.11.5.2 Electromagnetic fields

The electronic equipment rooms shall be designed in accordance to class 2 of IEC 801-3 or similar.

1.11.5.3 Fast transient interference (Burst)

The electronic equipment rooms shall be designed in accordance to class 2 of IEC 801-4 or similar.

1.11.5.4 High energy transient interference

The electronic equipment rooms shall be designed in accordance to class 2 of IEC 801-5 or similar.

1.11.5.5 Switching processes in high-voltage installations

The location of computer systems in the neighbourhood < 1m of high-voltage installations, such as medium voltage or transformer stations as well as direct parallel exposure of power and data cables should be avoided.

1.11.5.6 Magnetic fields

The following magnetic field strengths at the place of installation of cathode ray tube (CRT) based visual display units (VDU) should not be exceeded:

DC fields: 10 A/m or 12 µT

AC fields: 1 A/m or 1,2 µT

Locations shall be considered as the part of this contract. However, the location of Central Telecom Subsystem's Equipment setup shall be finalised during detailed design stage.

All equipment shall work in active-active mode (Hot standby). In case of unavailability of first CER equipment, the redundant equipment in another CER will take over without any human intervention and without any service failure / disruption to the end user.

As per technical requirement mentioned in GS & PS all the Telecom sub systems' Servers , controllers , consoles, HMLs , NMS work stations, Client Terminals , telecom equipment , end devices , licenses , software , firm ware , switching & processing capacity , and corresponding interfaces provisioned for first CER , same shall be replicated in second CER.

Telecom Contractor shall liaise and deploy initial setup to provide 3rd Party leased line connectivity with sufficient, dedicated & high availability bandwidth of approximately 1 Gbps from the Kanpur & Agra Metro Rail Projects to centralised OCC at Lucknow.

The cost of initial setup shall be borne by the Contractor while recurring payments shall be borne by the UPMRCL.

The Leased line connectivity shall comply with following SLA but not limited to- Availability- 99.99 %

3.7 Employer's Facilities

The contractor shall submit to the Employer's Representative details and notice of intention to use any of the Employer's facilities like works area and the period of usage. This shall be submitted in accordance with the provisions in the GS and PS. The Contractor shall note that the works areas may have to be relocated from time to time to suit the requirements of the Employer.

3.8 Contractor's Premise (Project Office, Site Office and Storage Space)

The KNPAGS-01 Contractor shall be provided space of approximately 4500-500SQM at suitable location to set up Project Office and Storage Space. KNPAGS-01 contractor shall be required to setup project office at project location and site office at site location and necessarily have to station at this Project Office and Site Office throughout the contract period. The key personnel for Project management, Procurement, Design, Implementation, Site co-ordination, Interface, Quality & Assurance, Testing and commissioning, maintenance etc. and shall submit a list for the same to review.

The Contractor will be provided a space of required size at suitable place to set up its Site office. The seat arrangement for Employer representative or Engineer representative shall be reserved as minimum 8 persons in site office.

- 1.10.1.5 Each FOTS Network Management workstation shall be connected with the common colour laser network printer work server and associated printer for alarm and event printout. The minimum specification of colour laser network printer is as follows:— provided in Appendix-F of Chapter-11 of PS.
- Produce up to 60 full-colour page per minute (ppm)
 - Add professional finishing and captivating colour in-house
 - Expedite print tasks with automated workflows and shortcuts
 - Print and share information via your personal mobile device
 - Produce more types of documents on a wider range of media
 - Minimise energy costs with a host of eco-friendly capabilities
 - Intuitive 25.65 cm Smart Operation Panel
 - USB/SD-Card Slot
 - Web Browser:
 - Automatic Duplexing
 - Internal Multi-fold Unit
 - 3,000 Sheet Finisher
 - Paper Trays and 100 Sheet Bypass Tray
 - Paper Feed Units
 - Large Capacity Trays
- 1.10.1.6 The FOTS Network Management system shall be equipped with mass storage device for storage of the configuration and alarm data-files.
- 1.10.1.7 The mass storage device shall provide facilities for downloading the configuration and alarm data files to storage medium, the files shall be in format easily read and processed by commercially available software. Any change in the network device shall automatically be updated on to suitable storage devices such that an up to date version of the configuration is available, in case of a system or power failure.
- 1.10.1.8 The Networking NMS shall be synchronized for time-of-day with the timing of the master clock via a LAN interface using NTP or PTP protocol.
- 1.10.1.9 The Core Switch in the CERs, should be modular chassis-based switch. Bidders should provide FCAPS certified NMS Solution for all layer 3, routers and layer-2 switches deployed in the network (OCC, stations, depots and Head Quarters etc), which can support & manage multiple vendor devices.
- 1.10.1.10 The software shall be compatible with Microsoft Windows and/or Linux operating systems.
- 1.10.1.11 The software shall come with an initial license for 1000 managed devices. The NMS software shall have the capability to extend the node limit in future by purchasing the additional node licenses.
- 1.10.1.12 Shall have rich Resource Management like Discovery, full inventory, L2/L3 and create Network connectivity topology based on L2 and L3 Connectivity parameters
- 1.10.1.13 Shall provide performance management including CPU utilization, Memory utilization, Bandwidth utilization, threshold-based alarming etc.
- 1.10.1.14 Shall support centralized VLAN Management to view current VLAN configuration, VLAN topology, bulk VLAN deployment etc.
- 1.10.1.15 Shall have integrated ACL Management to simplify definition and deployment of ACLs and perform ACL rule optimization.

- (i) from the onset of a failure detection to the completion of protection switching;
 - (ii) from the clearing of a failure to the completion of protection switching restoration in case of revertive switching;
 - (iii) from the activation of the restoration command to the completion of protection switching restoration in case of non-revertive switching; and
 - (iv) reframing time required by FOTS equipment
- 1.17.7 Concerning the GE network the maximum traffic interruption time on any circuit due to link, node or any other failure shall be less than 50 ms by using suitable open standard Ring Protection switching protocols.
- 1.17.8 The system response times of the FOTS Network Management System shall be as follows:
- (i) Commands presented to the FOTS Network Management System from FOTS management Workstation shall be processed and produce an appropriate output within 2 seconds maximum;
 - (ii) Real-time data presented to the FOTS Network Management Workstation from the network elements shall be processed and produce the appropriate output within 2 seconds maximum; and
 - (iii) Execution of parameter changes to GE IP Nodes initiated through the FOTS Network Management System shall be less than 2 seconds.
- 1.18 Equipment Design - General**
- 1.18.1 The FOTS equipment design shall be of standard rack with plug-in units. Hot-swapping capability shall be provided for all cards/units including redundant power supplies. Hot-swapping of the plug-in units shall not affect the equipment operation.
- 1.18.2 The Contractor shall use in his offer proven equipment with satisfactory results in equivalent networks and environment for a minimum period of one year after commissioning.
- 1.18.3 ~~A summary alarm indication shall be provided at the top of each rack to indicate the summary alarm status of the equipment within the rack. The alarms shall be visible over the equipment which have been installed inside the racks so that health of the equipment can be monitored.~~
- 1.18.4 Equipment shall be equipped with protected test points for measurement and performance monitoring without affecting the traffic. Test access facilities shall be provided at different transmission levels.
- 1.18.5 The FOTS equipment shall provide natural cooling arrangement, however if natural cooling arrangements are not adequate, the use of fan shall be provided.
- 1.18.6 The Contractor shall ensure that all the requirements of the specifications pertaining to interfaces are properly satisfied.

system assurance, installation, testing and commissioning of the Radio System as specified in this Chapter of the Particular Specifications

- 3.3.1.1 In addition, the Contractor shall co-ordinate with Project Contractors as defined in Clause 7 of this PS and provide comments or recommendation on subjects of station and depot building materials, finishes, architectural layouts and installation requirements for antenna supports. He shall also co-ordinate with the Civil Works Project Contractors to ensure the availability of proper duct / support facilities for all cables. The coordination and interface management shall be totally the responsibility of Telecom Contractor to see that the Radio System is timely commissioned.
- 3.3.2 Telecom Contractor shall assess the traffic requirements and level of usage of individual group of users to estimate the total loading and submit details such as frequency plan, traffic calculation, number of RF carriers, number of Base stations, masts / towers required, predicted coverage map at RF level bringing out the adequacy of the system to meet the expected levels of traffic and obtain approval of employer.
- 3.3.3 Based on a Radio Propagation study the Telecom contractor shall submit the proposed locations of towers and antennas to provide the specified area coverage throughout the elevated sections of UPMRC network including full indoor coverage.
- 3.3.4 The Contractor shall liaise with all concerned authorities including DoT, WPC, SACFA, civil Aviation authorities and other local authorities and obtain necessary clearances/sanctions for installation and commissioning of the Radio system. All costs, except Regulatory Fees, ~~therein have to~~ shall be borne by the Contractor.
- 3.3.5 The Contractor shall provide a digital, standard radio communications system conforming to the TETRA standards as defined by ETSI (and upgradable to future revisions) that should be capable of facilitating system wide voice and data communication to support the Operation and Maintenance of the UPMRC.
This shall include liaising for obtaining the frequency allocation & clearance also.

4. PERFORMANCE REQUIREMENTS

4.1 General

- 4.1.1 Further to the general performance requirements specified in CHAPTER 1 of this particular specification, additional performance requirements for the Radio system shall be as specified below.

- (1) Telephone system
- (2) FOTS System
- (3) Train-borne PA System
- (4) Station PA System
- (5) Train Control and Signalling System

4.4 Maintainability Requirements

4.4.1 The Mean Time To Restore (MTTR) of the Radio system to full normal operation following a failure shall be less than four hours excluding the time of travel. The travel time should not be more than one hour.

4.4.2 The service life of the GPRS RADIO System equipment except server/workstation shall not be less than 15 years. The service life of all types of cables shall not be less than 25 years. The service life of Server/Workstation shall not be less than 10 years. Service life shall be counted from the commencement date of Revenue Operation Date (ROD).

4.5 System Safety Requirements

4.5.1 All equipment must comply with, and be installed in conformance with IEC 65, IEC 364 or equivalent National Electric Code/Uniform Building Code of safety standards.

4.5.2 All metallic enclosures shall be provided with an earth terminal. Earthing of all equipment shall be in accordance with the overall guidelines for earthing laid down in Appendix – M of chapter 11 of this PS and also CHAPTER 1 of this PS.

4.6 Interoperability requirements

The Radio system supplier shall have previously demonstrated working radio interoperability tests between their radio equipment and the equipment of another radio vendor. The radio system supplier must submit documentation that has demonstrated interoperability. This test certification must be issued by only Accredited Test Houses of TETRA. The Inter-Operability Profile (IOP) certificates have to be submitted for the Switching Infrastructure Equipment. Copy of IOP Certificates issued for compliance to each of the following TETRA summary features for the Switching Infrastructure Equipment to be necessarily submitted as part of the Bid.

maximum data rate. The Telecom Contractor supplied system shall be up-gradable to support higher data rates by only software upgrades or upgradable to broadband services by adding broadband base station based on LTE or latest technology on the proposed same infrastructure. The Packet Data channels must coexist on the same Base Station site or Base Radio.

5.6.15.2.3 The system shall also be up-gradable to support higher data rates by only software upgrades or by broadband services by adding broadband base station based on LTE or latest technology on the proposed infrastructure. The Contractor has to submit documents along with his Bid to substantiate his claim in this matter.

5.6.15.2.4 Emergency Alarm to be provided.

The emergency alarm service allows a Mobile Station (MS) to send an emergency alarm to the dispatch system and the Radio Control Manager (RCM) application.

Only MSs can send an Emergency Alarm and the Alarm is delivered to all Dispatch Consoles (DCs) that have the affiliated talkgroup of the MS assigned.

5.6.15.2.5 Short Data Transport Service

The Short Data Transport Service (SDTS) lets applications access the point-to-point and broadcast TETRA Short Data Service (SDS) transfer over the air. It shall support messages of up to 140 characters per message. The radio system supports concurrent voice and SDTS transmission.

The SDS shall use TETRA Short Subscriber Identity (SSI) addressing and data shall be transferred between:

- Mobile Station (MS) to MS
- MS to fixed IP host (the IP host which has an assigned SSI and be registered with the TETRA Infrastructure)
- Fixed IP host to MS or group or broadcast (the destination devices must have assigned SSIs and be registered with the TETRA Infrastructure)

5.6.15.2.6 The system shall support Dedicated Data Channels. This shall be achieved by dedicating specific traffic channels to only handle data. Each Base Site shall be able to accommodate up to four of these dedicated Packet Data Channels (PDCHs).

- 6.3.3.5.2 The viewing distance for the platform display boards for each side shall be at least 40 meters for both Hindi and English characters when displaying in the biggest font size characters.
- 6.3.4 **PIDS Management System**
- 6.3.4.1 The PIDS management system shall be equipped with a proven Operating system (Linux/Windows/Solaris etc) to support the specified management functions.
- 6.3.4.2 Each management Workstation shall be equipped with a 24" inches colour LED display with at least "1280 x 1024" pixels resolution to provide graphical presentation and display of the PIDS/PAS.
- 6.3.4.3 The mass storage device shall be provided with a storage capacity for at least 4 weeks of alarm data, system configuration data, alarm history, and system event logging data.
- 6.3.4.4 4 Notebook Computers loaded with appropriate software for field maintenance shall be supplied for PIDS management. The notebook computer shall be powered by an internal rechargeable battery supporting more than 4 hours continuous operation without recharging. Appropriate softwares shall be pre-loaded onto the notebook computers to access full management facilities through the local maintenance port. Please refer **Appendix-F** of Chapter-11 of the PS for technical specification of Notebook computer. The specification of Notebook Computers are also given in chapter-2(FOTS) of this Particular Specification.
- 6.3.4.5 The Contractor shall provide a PIDS management system for the overall control, supervision, maintenance and configuration of the entire PIDS. It is envisaged that one NMS and a corresponding workstation shall be provided at both ~~locations of OCC and BCC~~ CERs of Kanpur & Agra Metro Projects. The NMS at ~~OCC and BCC~~ CERs shall have jurisdiction over whole ~~Phase-1A stations~~ Kanpur & Agra Metro projects. The NMS should not be available for access in other than CSS/CER. The PAS & PIDS NMS shall be on the same server and workstation.
- 6.3.5 **Cables & Power Supply System**
- 6.3.5.1 PIDS display boards shall be connected by either serial or LAN connections or through Optical Fibre Cable to the station PIDS control equipment. All cables shall be as per the Cable specifications detailed in the Appendix-D chapter 11 of this PS for Cables.

INTRODUCTION

1.1 General

1.1.1 This Chapter specifies the particular technical and performance requirements of the Master Clock system of the Telecommunications System.

1.1.2 This Chapter shall be read in conjunction with other Chapters of the particular specification, General Specification (GS), General Conditions of Contract (GCC), Special Conditions of Contract (SCC), Instructions to Tenderers (ITT) and other documents forming part of the contract.

1.2 Overview of Master Clock System

1.2.1 The Master Clock System shall be compliant with ~~ITU-T G.811~~ relevant ITU-T standards as per FOTS specifications. It will serve as Primary Reference Clock (PRC) for all clock functions of the UPMRC. The Master Clock shall provide synchronised time signals received by radio communication from orbiting GPS satellites. The Master Clock shall derive Coordinated Universal Time (UTC) from received GPS satellite signals and shall convert this to local Indian Standard Time. The Telecom Contractor shall provide the Master Clock for Date & Time signal also so that it can act as NTP server for the Master Clock System of UPMRC network.

1.2.2 Master Clock system to be provided under Telecom Contract shall consist of following major components:

- (1) GPS Master Clock Unit working in active-active Redundant mode at CERs levels.
- (2) Sub-master clocks at each of the station, RSS and depot.
- (3) Indoor Digital Slave clocks at all stations, depots, OCC, RSSs and CERs.
- (4) All power and signal cables, shall have surge protection devices etc.
- (5) Both primary and secondary fixtures for installation;

In addition of above, NMS Workstation alongwith 30" monitor shall also be provided at CERs for supervision and maintenance of Master Clock System at all stations, depots, OCC, RSSs/TSSs etc. provided under Telecom contract.

2 Network Time of Day

- (2) Master Clock system synchronized to GPS with Date/Time shall distribute the signal to Sub-Master clocks. In the absence of valid Master Clock signal, the Sub-Master clocks shall operate in free running mode with an internal clock supplying the time signals. On restoration of the master clock signal the submaster clocks shall validate the signal. After the successful validation, the sub-master clocks shall self-correct, if necessary.
 - (3) Sub-Master Clocks shall further distribute the synchronized signal to all slave clocks. In the absence of valid Sub-Master Clock signal, the Slave clocks shall operate in free running mode with an internal clock supplying the time signals. On restoration of the Sub-Master clock signal the Slave clocks shall validate the signal. After the successful validation, the Slave clocks shall self-correct, if necessary. The Master Clock unit, Sub-master Clock unit and Slave clocks (digital) shall have internal battery backup of at least 4 hours for continuous display of date & time without any interruption.
 - (4) Sub-Master clocks, synchronised to the Master clock system, at stations, depots, RSSs and OCC/CERs, shall provide clock sources to the slave clocks of stations/depots.
 - (5) Sub-master clock shall supply timing signals to the voice recording equipment (CDRS), the train control & signalling system, FOTS, PIDS, PAS, Radio System (with CDRS), Telephone system, CCTV System, power supply sub-system, T-SCADA, OA&IT, other SCADA systems, the AFC central computer and other necessary equipment to be finalised at design stage.
- 5.3 Alarm and status monitoring of the Master Clock System shall be connected to the NMS of Master Clock System in CERs. MMI shall be provided at CERs for supervision and maintenance of all stations/depot/OCC/RSSs, etc clocks provided under this contract.
- 5.4 The Master Clock and/or Sub-Master Clock system shall provide appropriate clock output interfaces for master clock and timing and reference distribution. The type and quantities of the clock output interfaces shall be determined by the interfaces requirements of the subsystems (PAS, PIDS, Radio, CCTV, CDRS, Telephone System etc) and relevant interfacing project contractors (Traction, Fare Collection, Train Control and Signalling etc.). Suitable interfaces (such as RS 422 or RS232 or LAN connections) for clock output interfaces shall be supported.
- 5.5 Clock output interfaces of Suitable standards (such as RS-422 or RS232 or LAN) in form of suitable outlets (such as RJ-45) shall be provided within station concourse and platforms at locations where the station clocks are mounted. Similar arrangements shall also be provided

for depot. The Sub-Master Clock at stations shall also provide reference clock for PIDS Clock Display.

5.6 The Master Clock system shall be self-correcting in the event that the synchronisation signal is lost and re-established. Master Clock system shall be synchronized to GPS with Date/time. In the absence of valid GPS signal, the Master Clock system shall operate in free running mode with internal clock supplying the time signal. On restoration of the GPS signal the receiver shall validate the GPS signal automatically without any manual intervention. After successful validation, the Master Clock system shall self-correct, if necessary.

5.7 Digital Slave Clocks to be built to Open Protocol (like AFNOR, ~~VNTP V4~~ NTP V3/V4 or latest one etc.) and to work on this Open Protocol only. In this reference following points must comply:

- (1) Only open protocols are allowed.
- (2) Use of the protocol should be free and no limitations should be there for its use by the third party.
- (3) Slave clocks from third party shall be able to work this protocol and this should be demonstrated as part of this contract.
- (4) Slave Clocks exposed to outdoor, station Platform and Concourse environments shall be designed, manufactured and installed to survive the environment with IP 66 standard and those used in indoor environment (Rooms) with IP54 standard.

6 DESIGN REQUIREMENTS

6.1 General

In addition to the Design Engineering requirements given in Chapter 1 of this Particular Specification, the Contractor shall submit the following information to the Employer's representative for review:

- (1) Details of Clock distribution system to accommodate requirements in CERs, all stations, RSSs/TSSs and depots.
- (2) Master clock unit shall be in 1+1 configuration for all equipment and in any case master clock unit should not be absent.
- (3) Details of the synchronisation plan for the sub master clocks with master clock system and sub master clocks with slave clocks.

at each station and, Industrial grade Access switches as described in FOTS chapter of this PS (To be provided at outdoor locations where Air-conditioning is not provided), Fiber cable, video cable, power cable, etc. This shall be integrated for viewing and control at a central location at OCC, CERs, etc using the Network of layer-3 switch. Selected Video images of each station, depot and the wayside cameras require to be transmitted to the OCC, CERs, etc. On the other hand, the control signals of Video image selection for any camera and Pan / tilt / zoom control require to be transmitted from the OCC & Security Control Rooms to the TER of every station.

2.1.2 Depots

At the depots, cameras shall be provided inside the depot connected to the NVR located in the TER and thereon to the Monitor in the DCC for display to the Depot Controller and Depot Security Controller. The same shall be connected to the CER through the Layer 3 Network, for both viewing live and recorded video ~~and also for occasional recording~~. Camera shall also be provided for train entering in the Depot area.

2.1.3 RSSs/TSSs

Minimum 04 IP Based IR illuminated Cameras in each RSS & TSS is to be installed and video of these cameras are to be integrated at the nearest station for viewing and recording (both local and mirrored) purpose. The Contractor must ensure the coverage for critical areas of RSS as per Employer consent and full coverage of RSS boundaries.

2.1.4 Signal Point Crossings.

Minimum 02 IP Based IR illuminated Camera to be provided at all Point crossings (for Each Turnout). The contractor must ensure the full coverage of the areas among Signals, Points & Crossings of concerned stations.

2.1.5 Ramp Area

Minimum 02 IP Based externally illuminated IR Camera at each Ramp are to be installed and video of these cameras are to be integrated at the nearest station for viewing and recording (both local and mirrored) purpose.

2.1.6 Externally illuminated IR Camera

Externally illuminated IR Camera is to be installed at following installations: Stations & Depots Main entry (Outside Shutter/Gate), Stations/Depots Parking, Platform ends, Signal Point crossings, Ramps, TSSs, RSSs and theft prone areas.

2.1.7 Video Wall at Security Control Rooms

6.2.1.4 Unless specified otherwise elsewhere in the PS, Cameras, field switches, ~~PF Monitors~~ & other equipment, meant for outdoor installations, shall be suitable to work from 0°C to +60°C 50°C with RH up to 90-80% non-condensing.

6.2.1.5 The data sheets from the OEM of the cameras, for outdoor and indoor are to be specifically conforming to the above in regard to the temperature and humidity requirements. The data sheets shall be submitted with the Technical Description in the bid documents.

6.2.2 **Varifocal Lenses:**

6.2.2.1 Varifocal Lenses compatible with 2 MP fixed box type cameras without compromising the resolution/picture quality shall have the following specifications as minimum:

1.	Focal length	9mm – 50mm
2.	Iris range	f/1.5 to f/1.8
3.	Format	1/2.8" or better, 2MP, IR corrected.
4.	Lens mount	i-CS-mount
5.	Angle view wide (1/2.8")	30° x 19° or better
6.	Angle view tele (1/2.8")	6.6° x 3.8° or better
7.	Iris Control	P-Iris Focus control
8.	Focus Control	Auto (i-CS)
9.	Zoom Control	Auto (i-CS)
10.	Operating Temperature	-10°C to +55° C
11.	Storage Temperature	-10° C to + 60° C
12.	Operating Humidity with camera and housing	Up to 90%, non-condensing
13.	Approval (Safety & EMC Immunity, Emission)	CE or equivalent.
14.	Makes subject to meeting the above requirements.	Only from a reputed make. Printed data sheet of manufacturer to be attached with the bid proposal, clearly identifying clause by clause compliance.

6.2.3 **Housing Arrangement for Fixed IP box type camera:**

6.2.3.1 Housing arrangement shall be designed for both outdoor and indoor use and shall meet requirements for camera enclosures.

		Printed data sheet of manufacturer to be attached with the bid proposal, clearly identifying clause by clause compliance.
--	--	---

6.2.11 IR Illuminator

LED type	12pcs 2W dot-matrix IR LED or better
Wavelength	850nm
Voltage	AC24V
IR distance	120 m
Angle	35°
Power consumption	28W or better (850nm)
Day and night switch	Auto (build in photocell)
Cable length	1.3meter
Mounting Wall mounting	"U" bracket
Temperature	-40°C to 50°C
Grade of protection	IP66
Color	As per station aesthetics
Housing	Aluminium
Panel	High light transmittance toughened glass

6.2.12 Layer 2 Switches for Field:

The specification for switches used for CCTV System has been provided in the chapter-2 (FOTS) of the PS. Telecom contractor shall calculate the requirements of type/nos. of ports and switches as per their design and submit the same for the review and approval of Engineer or Engineer representative. Ethernet output from the IP cameras (Fixed and PTZ) shall be directly connected to the field switch through data cable and suitable protection devices. The outputs of the field switch shall be connected to the two aggregate switches by using 2 x 1Gigabit Fibre Uplinks through separate optical fibre cable to the redundant ports available in TER switches.

For powering the PTZ, if the power (PoE/PoE+) available on the field switch ports is not sufficient to drive the PTZ functionalities, a separate power cable shall be laid by Telecom Contractor.

6.2.13 Requirement of Large Video Wall

Annexure A

Requirements of 3x2 x 70" Large Video Screen

The large video screen graphics wall in each Security control room shall be used for the display of important Images from IP video cameras, graphics from the PC, Workstation, etc. It should have the functionality to pre-configure and save various display layouts to be accessed at any given point of time with a simple mouse click. The Video Wall arrangement including all equipment, accessories, cables, mounting structure/frame, Controllers, Wall management Software, etc shall be provided and implemented by the Telecom Contractor.

The cube and controller should be from the same manufacturer and the display OEM shall have its own service centre in India.

The large video screen should be able to show the images of the monitor, which is connected on the LAN with Windows XP/Windows7/Windows10 or the latest OS and the windows should be freely resizable, re-scalable and repositionable on any part of the large video screen. Normally all the stations of the OCC & CERs jurisdiction shall be viewed simultaneously on the full 3x 2 Video Wall at Security Control Room in Depots/Admin Buildings windows of equal sizes. Thus, each window shall represent one station view on which sequentially all cameras of that particular station shall automatically be displayed. However, in case required, the configuration can be changed and even it shall be possible to see a single camera view on the full Video Wall. It shall be possible for the user to define different views and sizes and save them, so as to be used as and when required.

The large video screen graphics wall shall be consisting of multiple rear projection modules in multiple rows and columns behaving as a single logical screen.

The display wall should be rugged and industrial nature and should be able to work in 24*7 environments.

A. Display unit:

The display wall should consist of the Visual Display Unit, Mounting Stand, Display Controller and the Wall Management Software, which should be supplied from a single manufacturer with the following specifications:

1. 4-2K Laser based Large Video Screen Wall Cubes of 70" Diagonal 3 (C) X 2 (R) configuration with Complete equipment along with Base Stand and other accessories.
2. Should have the scalability and upgradeability to be made up of multiple rear projection modules stacked up in rows and columns to achieve a display wall for better viewing ability in linear or curved configuration.
3. The Rear Projection Modules must be based on Single Chip DLP (Digital Light Processing), Ultra Full HD Native, and Rear Projection technology.

4. The DMD (Digital mirror device) chip should have minimum ~~8~~ 2 Mega pixels and the DMD mirrors should be square in shape.
5. The Large Video Screen Graphics Wall shall be installed in each Security Control Room at Depots/Admin Buildings. The Large Screen Graphics Wall shall be made up of 6 Rear Projection Modules fitted in 3 columns wide and 2 rows high.
6. The overall resolution of the full graphics wall shall be minimum ~~11,520 x 4,320~~ 5,760 x 2,160 pixels.
7. The Minimum Diagonal Size of each Visual Display Unit / Rear Projection Module should be 70" nominal with a native resolution of ~~3840 x 2160 4K Ultra~~ 1920x1080 Full HD and should offer 16.7 million colours.
8. The life of Laser in economy mode should be minimum 1,00,000 hrs.
9. The replacement of defective laser module should be possible in field with MTTR < 4 hours.
10. The brightness uniformity of each display should be greater than 95%.
11. The Dynamic contrast for each cube will be 1,000,000:1 or better (Typical).
12. The brightness of each projection engine shall be minimum ~~2200~~ 1100 lumens (Typically). The luminance on each rear projection module (display) shall be ~~450~~ 250 nits (cd/m²) or higher.
13. Each of the Rear Projection Modules should have an arrangement to adjust the brightness of individual projection module automatically to have a completely uniform graphics wall over time without compromising the contrast & colours.
14. Each cube shall have its own IP address to have the access from a standard web page from any PC over the Ethernet and shall communicate to a viewer via Ethernet.
15. The screen should be of almost Zero Gap technology (Inter-screen gap < 0.2 mm). The screen should be minimum three layers with a Hard backing to prevent bulging. The screen surface should not be reflective with the half gain / viewing angle of the screen used in $\pm 36^\circ$ horizontal and $\pm 34^\circ$ vertical position.
16. Each cube shall be IP based control. The control board input terminals to projection module will be 1x Digital DVI, 1x Dsub-15, 1x HDMI 2.0, 1x Display port 1.2, have a flicker free image on the Large Video Screen Graphics Wall.
17. Each cube shall be equipped with Redundant Dual Power Supply which should be built in as integral part of projection system. Dual inbuilt power supply should be hot swappable. Cooling inside cube shall be by means of a heat pipe.

18. Each cube should have a screen size of 1550 mm wide and 827 mm high. The cube depth should be less than 750 ± 5 % mm.
19. Projection unit should be designed based on International Electrotechnical Commission-60529 standard. Projection unit should be certified by 3rd party lab to conform the design meeting the requirement of IEC -60529 standard. Test certificate should be submitted as a proof along with technical bid submission.
20. System shall be able to switch to secondary input if primary input is not available and automatically switch back to primary input from secondary input as soon as the primary input is available again.
21. Large Video Wall shall be equipped with a cube control & monitoring system and shall be able to control & monitor individual cube, multiple cubes and multiple video walls. It should have an Infrared (IR) remote control for quick access.
22. Monitoring of critical parameters like internal temperature, brightness, cooling, light source status should be possible to demonstrate through active monitoring interface.
23. Power consumption for each Visual Display Unit / Rear Projection Modules should be minimum~350 watts.

B. Display Controller:

The Complete Display Controller including I/O Modules, encoding and decoding units shall be redundant with auto switchover facility to ensure that no single failure of any controller or I/O module/encoder/decoder shall result in failure/blanking of a zone on the display wall. The Display controller should have the following specifications:

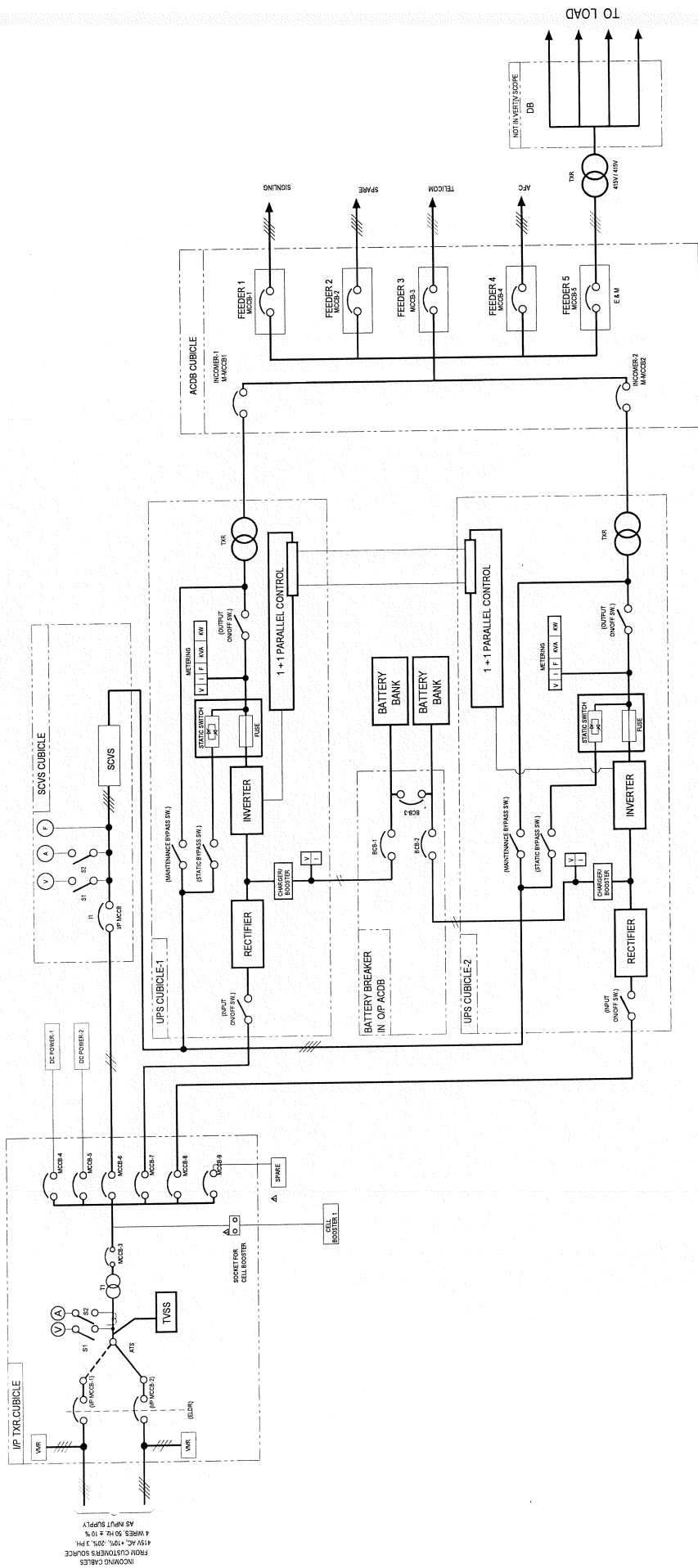
1. The Controller should have BIS certification. The Controller should be in an industrial 19" rack mounted casing based on server architecture ~~having processor Intel Xeon i7, 3.0 Ghz or better~~. Please refer Appendix-F of Chapter-11 of PS for server specification.
2. The minimum memory (RAM) of 8GB (standard) or higher, expandable up to 32 GB and should be DDR3 or latest type.
3. The unit should be equipped with a pen drive of suitable size for bootable software/other software requirement.
4. The system should be equipped with minimum 500 GB HDD in RAID 1 Configuration.
5. The display controller should have dual redundant hot swappable power supply.
6. Should have 10/100/1000 Mbps Redundant Ethernet port for LAN connection.

7. Supplied with a Keyboard and mouse with 20 m cable extension.
8. The Display Controller should be based on Windows XP/Windows 7/10 or higher or Linux.
9. It should give minimum 6 multiple DVI-D graphics outputs to be connected to the multiple rear projection modules.
10. There should be possibility of connecting the various types of Analog and digital sources using inputs in freely scalable and moveable windows on the graphics wall. It should support 2 Nos. of universal inputs:
 - DVI-D/HDMI
11. The controller shall interface with hardware accelerated streaming video decoding using streaming video decoding unit.
12. There should be possibility of connecting minimum 40 120 Streaming Video Inputs of 2 MP (~~3072x1728~~ 1080x1920) cameras with H.264,H.265 compression mode from different IP based Surveillance Cameras installed at stations/depots to this controller to show the multiple Streams sources in scalable and moveable windows on the graphics wall.
13. The decoder unit shall have a dual 10/100/1000 Base-T failover Ethernet interface. The decoder unit shall support IP, SNTP and TCP video stream formats.
14. The decoder unit shall support Non-proprietary MPEG-4, MJPEG, H.264, H.265 and latest compression protocols.

C. Software:

The Software should have the following specifications:

1. The software should be able to pre-configure various display layouts and access them at any time with a simple mouse click or based on the timer.
2. The software should enable the users to change the size and position of the various windows being shown on the Display Wall.
3. The software should enable various operators to access the display wall from the local keyboard and mouse of their workstation connected with the Display Controller on the Ethernet.
4. The software should copy the screen content of the Windows XP/Windows7/10 workstations (Showing semi static content) connected on the Ethernet with the Display Controller to be shown on the Display wall in scalable and moveable windows in real time environment.
5. User can schedule the layout on specific date & time, weekday, weekend, start & end date. It should be possible to create offline layouts



Section I: 3 phase 415 V UPS System

1. SCOPE OF THE WORKS, SUPPLY AND SERVICES

1.1 General

- 1.1.1 The scope of the works includes but not be limited to supply, manufacture, inspection, packing, shipping, transportation, storage, delivery, handling, insurance, installation, interfacing, integration, testing & commissioning, maintenance support, spares, special tools, test equipment, training, documentation and providing DLP for the UPS system.
- 1.1.2 The UPS system provided by the contractor shall be 135 KVA for Depots, 75 KVA for OCC & Interlocking stations and 45 KVA for Non-Interlocking stations with on-line redundant configuration along with SCVS, PDU with ATS along with input and output Isolation Transformers, Distribution Boxes along with Battery Breaker cubical and a separate 20 k VA output isolation transformer for E&M supply only along with all associated accessories.
- 1.1.3 This specification describes the electrical, mechanical characteristics and requirements of three phases, on-line, double conversion, ~~Modular Hot Swappable~~ Uninterruptible Power Supply (UPS). The UPS should be having VFI (Voltage Frequency Independent) technology, fully DSP controlled power factor corrected rectifier and IGBT inverter capable of providing high quality AC power for sensitive electronic equipment loads.

1.2 Scope of supply

- 1.2.1 The Uninterruptible Power Supply (UPS) system shall include, but not be limited to the following:-
- a. Online hot-swappable modular redundant UPS with suitable size modules.
 - b. Battery bank;
 - c. Spare cell charger;
 - d. Input Isolation Transformer Cubicle
 - e. Power Distribution Unit
 - f. SCVS;
 - g. Output isolation transformer for all subsystems
 - h. Output isolation transformer for E&M supply;
 - i. Equipment cabinets, racks & cubicles;
 - j. Distribution boxes, Battery Breaker Cubicle;
 - k. Cable trays/Trenches/Supports/Foundations;
 - l. ATS (Automatic Transfer Switch);
 - m. All software required for UPS system;
 - n. All external cables (Zero Halogen FRLS), connectors;
 - o. Accessories, earthing necessary for works;
 - p. Contract Spares;
 - q. Surge protection devices;
 - r. Special tools and test equipment;

- 2.1.2 The complete UPS system, except VRLA cellblocks, shall have a minimum service life of 15 years operating continuously. The service life of all the cables shall not be less than 25 years. All equipment and components supplied under the Contract shall have proven reliability and shall be designed, manufactured and installed to meet the specified and / or relevant international or national standards. The Contractor shall submit to the Engineer for approval, a list of all supplied equipment and components with a declaration of conformance to standards. The Service Life of Server/Workstation shall not be less than 10 years. Service life shall be counted from the commencement date of Revenue Operation Date (ROD).
- 2.1.3 Equipment shall be designed and manufactured in modular manner to facilitate the fault diagnosis and replacement of each modular part. Each module shall be capable of being interchanged with other modules of the same type without affecting the rest of modules in place. ~~Power Module of suitable rating with unity power Factor & Hot Swappable STS Module, Controller & Aux Power Board.~~
- 2.1.4 The Contractor shall plan, perform and record all quality control activities to ensure that all work is performed in accordance with the requirements of the Contract. Such activities shall include, without limitation, the inspections and/or tests expressly or implicitly required ensuring quality of system.
- 2.1.5 Reliability, Availability and Maintainability requirements shall be demonstrated by the Contractor on quarterly basis, for continuous four quarters.
- 2.1.6 ~~UPS should be configurable for Energy Recycle Mode that enables testing of the unit for load testing without external load to test & verify the UPS~~
- 2.2 Reliability Requirements**
- 2.2.1 The inability to perform a required function, the occurrence of unexpected action by the equipment, or the degradation of performance to below the required specifications shall constitute a failure.
- 2.2.2 MTBF figures specify the minimum reliability requirement of all major equipment. If higher MTBF figures are required to achieve the required level of System availability, the Contractor shall adopt suitably higher MTBF figures in equipment selection.
- 2.2.3 The Contractor shall ensure reliability throughout all aspects of the manufacturing, installation and testing as necessary to satisfy the reliability requirements.
- 2.2.4 The contractor shall ensure that the reliability of UPS system shall meet the figure >50,000 hrs of MTBF.
- 2.2.5 ~~Redundant System with redundant controller, Dual Aux Power Supply.~~

3.12 Alarms shall be implemented through suitable NMS, placed at CERs/CSSs to be provided by Telecom Contractor, for the Battery Backup System using a suitable interface such as RS-232 TCP/IP etc. The exact interface and channel requirement will have to be finalized by Telecom Contractor. The following alarms shall be provided for each of the two SMPS/Battery Banks from the NMS at the CERs:

- (1) Mains fail
- (2) Operation OK
- (3) Input voltage high
- (4) Over load
- (5) Boost mode
- (6) Float mode
- (7) Rectifier Modules fail (one or more than one)
- (8) Mains low
- (9) Battery cut off pre-alarm
- (10) Over temperature
- (11) Summary Alarm

3.13 NMS shall be provided on a TFT based MMI kept in CERs/CSSs for monitoring all alarms of 48V DC Power Supply System.

4. System Expansion

The SMPS system shall be designed and equipped with all necessary hardware, software and capacity for future 25% additional load. Modular SMPS Frame must have the provision to add required power modules to cater 25% spare capacity.

5. Single Line Diagram for UPS and SMPS power supply system is added in the PSS chapter of Particular Specification.

SECTION-II SPECIFICATIONS FOR SMPS BATTERY BACKUP SYSTEM 48 V DC

1. Battery Backup system - General

- 1.1 The Battery Backup provided by the Contractor shall be sized to power its full load including Radio System, & Telephone System with redundant configuration (two numbers of line protecting devices, two numbers of Battery Chargers and two banks of 48 volt battery banks) for busy hour reserve of four two hours by each 48V battery bank for equipment installed in TER at stations, TER at depots and CERs.
- 1.2 In case the Telephone & Radio system does not require 48 VDC and can work on 230 V AC, then their load need not be catered to in DC System. But its load should be catered in the UPS.
- 1.3 Two independent 3-phase primary power input feeder cables shall be made available inside the UPS/Battery Room to the S&T Contractor by the concerned System Wide Contractor (E&M/Traction Contractor).
- 1.4 Automatic Changeover between the two mains incoming AC supply feeders and further distribution shall be provided by the Telecom Contractor
- 1.5 Telecom System Contractor will use 3 Phase AC inputs for the chargers of the battery backup system from the distribution panel after the automatic changeover switch and the MCBs. Each of the two chargers shall have independent 3 Phase AC input feeder from the distribution panel.
- 1.6 The Battery shall consist of VRLA (maintenance free) cells. The battery bank shall be of suitable high voltage, the use of which may be justified. The banks shall be formed of cells of similar capacity and voltage rating.

2. Battery Back Up Equipment

2.1 General

- 2.1.1 The battery backup equipment shall conform to an international standard covering safety, construction, electromagnetic interference and operation or to the latest version of the following:

- | | | |
|-----|-------------------------|-------------------------|
| (1) | RFI Suppression | : EN 55022A or VDE 0878 |
| (2) | Boost cum float charger | : IEC 146 |
| (3) | Protection class | : 1- EN 60950 |
| (4) | ISO 9001 | |

3.13.5.2 Any electrical joints in the earthing system shall be protected from moisture ingress by using proper wrapping, sealing with waterproof tapes, or such other measures.

3.13.6 The equipment chassis shall be connected to suitable earth.

3.13.6.1 The earthing methods and details shall be submitted to the Employer's Engineer for review.

3.14 Requirements for effective transient and surge protection

3.14.1 Physical distance from the transient source does not necessarily guarantee immunity from transients and an effective transient protection system must protect the equipment from transients. Transient Protection Class 'B' as per IEEE 62.41 & 62.45 shall be provided at the UPS input side as a minimum.

4. System Expansion

The UPS system shall be designed and equipped with all necessary hardware, software and capacity for future 25% additional load. ~~Modular UPS Frame must have the provision to add required power modules to cater 25% spare capacity.~~

(17)	Battery Charging by each UPS in Boost Charging	C/10 rate
(18)	Battery Charging Characteristics and Charging Voltage	In accordance with VRLA battery specifications

Source of power is from RSS/ASS which supplies Traction as well as Auxiliary loads of Metro Operations.

3.2.10 The UPS shall comprise of the following controls and protection:

- Emergency power off
- Maintenance bypass isolator
- Battery isolator
- Low battery shutdown and trip
- DC over-voltage
- Charger current limit
- Thermal protection
- Ambient temperature protection
- Phase Sequence Protection
- Suitable alarm interface
- Remote monitoring

3.2.11 The UPS shall offer at least the following facilities:

- ~~Mode selection: online Mode, Green Mode, ECO Mode, Energy Recycle Mode & Frequency conversion mode~~
- Log & Statistical Data Reset & Firmware upgrade
- Inverter: Voltage / Frequency / Eco Mode / Frequency converter
- Maintenance log
- Alarm contacts
- Communication port
- Diagnostics and self-testing

3.2.12 The UPS system shall have at least the following LED-10" displays:

- Rectifier input voltage & current
- Bypass input voltage and current
- Inverter output voltage and current

DC bus voltage, current and capacity

Output frequency

Load: In kVA/KW/Percentage

Temperature: STS/Inverter/PFC

Available battery backup time

Ambient temperature

Load on Main Source

Load on Standby Source

UPS in service

System in Bypass mode / UPS failed

Normal UPS Supply available for Telecom, S&TC,AFC systems and E&M System.

- 3.2.13 Alarms, health status & displays generated by each UPS shall be shown locally, as well as at remote location in CERs at one separate terminal each in respective CERs.
- 3.2.14 All alarms and messages generated by the UPS shall be recorded at least for a period of six months and self-clearing of message in FIFO logic.
- 3.2.15 Telecommunication contractor will provide LAN port between each station and the CERs for communication purpose, the point of interface being TER (Telecom Equipment Room) at stations and CERs (Central Equipment Rooms) at Depots. Telecom Contractor shall make all other necessary arrangements such as communication card/ port, cabling from UPS to TER, networking, furniture, workstation etc. The workstation shall be a standard PC with latest configuration and 30" LED monitor.
- 3.2.15.1 Alarms shall be categorised on these remote terminals based on different severity levels and shall be both acoustic and visual to draw the attention of maintenance personnel in case of need.
- 3.2.15.2 Remote monitoring system shall have state of the art features such as –
- Graphical tool illustrating health status of various equipment on a single screen, such as line diagram: normal status of all equipment at a station shown in Green colour and fault status shown in Red colour. The status can be zoomed at various levels to identify specific faults to card or component level.
- The Contractor may propose alternate graphical scheme for review and acceptance of the Engineer.
- Automatically generating and sending messages to each NMS;

3.2.9 The following data shall apply to UPS (of complete system unless specified otherwise):

(1)	Output capacity (KVA) of each UPS	135 KVA for depot 75 KVA for interlocked stations and OCC 45 KVA for Non-Interlocked stations
(2)	Input voltage (Three phase) of input feeder	415V AC +10%, - 20% #
(3)	Input frequency of input feeder	50 Hz , ± 5%
(4)	Input Power factor	> 0.99
(5)	Output voltage	415V AC Three phase
(6)	Output frequency	50 Hz ± 1% (except in bypass)
(7)	Voltage Regulation: Static Dynamic (0-100-0% Load Step)	Better than ± 1% Better than ± 5%
(8)	Overload capacity of each UPS better than	> 150 % for 60 seconds > 125 % for 10 minutes > 110 % for 60 minutes
(9)	a. Total Current Harmonic Distortion of each UPS at input (THDi)	<3 %
	b. Total Voltage Harmonic distortion of each UPS output	< 3% for 100% linear load <5% for 100% nonlinear load
(10)	Crest factor of each UPS	≤ 3:1
(11)	Ambient Operating temperature	0-50 °C
(12)	Storage temperature	0° C to + 70°C
(13)	Relative humidity (non-condensing)	Up to 95% at 40 °C
(14)	Efficiency (AC-AC) of complete system (including input and output transformers)	Better than 90% 80% (From 25% load to full load)
(15)	Inverter efficiency (including output transformer)	Better than 0.95 0.93
(16)	Ripple content: With Battery	< 1%
	Without Battery	< 2%

- f) Short Circuit Power Protection
- g) Frequency Control
- h) Inverter Output voltage Harmonic distortion
- i) Inverter Overload protection.
- j) ~~Dual CAN Bus redundancy to enable UPS to be removed or inserted UPS in parallel configuration without need of transferring it to bypass mode.~~

3.2.7.3 The inverter shall be capable to supply its rated load at power factor of at least 0.8 leading or lagging.

3.2.7.4 Voltage harmonic distortion: The inverter shall provide sine wave output having harmonic neutralisation and filtering to limit the total harmonic distortion on the output voltage to less than 1% of linear load and 5% of non-linear load.

3.2.7.5 Each inverter leg shall be protected from over-current to prevent damage to the solid-state devices in the inverter bridges.

3.2.7.6 The inverter output shall be electronically current limited.

3.2.7.7 The inverter shall be protected against over voltage and under voltage surges introduced at the output of the uninterruptible supply system by load switching and transfer to the bypass. If the bypass AC line deviates by more than 50 Hz \pm 1% the inverter logic shall automatically revert to 50 Hz \pm 0.25% and initiate an alarm condition.

3.2.8 Automatic Static Bypass Switch

3.2.8.1 The UPS shall be provided with a static By-pass switch. In the case of inverter failure, sub circuit failure, load start-up inrush or battery capacity being exhausted upon rectifier / charger supply down, the static bypass switch shall transfer the load to the mains automatically within 4 milliseconds. Full protection discrimination shall be achieved on the bypass circuit. In case of a single sub-circuit fault, the capacity of the static by-pass switch shall withstand the fault energy until the protective device of the sub-circuit clear the fault. Static bypass module also should be hot swappable, in case of any fault, same should be replaceable without any shutdown the UPS.

3.2.8.2 The means of operation shall ensure a make-before-break uninterrupted transfer of load to or from the by-pass supply source under both automatic and manual mode of operation. The static switch should also conform to the following minimum requirements:

Continuous Capacity	Equal to the 100% continuous rating of the inverter
Overload Capacity	Equivalent to the overload characteristics of the UPS

- 2.9.3 Selection of MCCB and MCB shall be considering electrical light load. Total Discrimination must be available between the various elements of switchgear selected. The Electronic trip units shall comply with the requirements of EMC/ EMI Compatibility of IEC 60947-2 or EN 60947-2, in case of MCB, Circuit protection against overload and short-circuit conditions shall be provided by means of thermal-magnetic device. Double-pole (DP), triple-pole (TP), and four pole (FP) MCBs shall be integral units and interlocked internally so that an over current through any pole shall trip all the poles of the MCB simultaneously.

3. TECHNICAL REQUIREMENTS

3.1 General

- 3.1.1 The UPS and their constituent parts shall comply with the relevant latest version of British Standards, European Standard (EN), International Electromechanical Commission (IEC) standards, International Organization for Standardization (ISO) Standards as specified in this contract.
- 3.1.2 Provision of suitable earth leakage detection both for DC and AC supplies and alarms shall be made individually at each location (station/ depot etc.)
- 3.1.3 The ~~Hot swappable modular UPS with maximum of 6 modules vertically and 8 frames horizontally.~~ and Battery backup system for S&TC and Telecommunication system shall include 2 numbers 3-phase Output, N, PE (TN-S) UPS in online redundant configuration powered by Two separate Battery Banks (one for each UPS at each station and Depot, a stand by spare cell charger (for 1to 6 UPS cells) and a spare cell bank with 6 numbers cells
- 3.1.4 The transformer insulation class shall be in accordance with heat they are likely to generate but in no case the insulation Class shall be worse than Class B-H insulation. The Contractor shall submit detailed calculations to substantiate his design.

3.2 Equipment Design of UPS System (415V AC 3 phase)

- 3.2.1 The UPS shall include PDU with Isolation Transformer, rectifier, battery, charger, inverter, solid-state bypass switch, Servo Controlled Voltage Stabilizer in bypass path and output Isolation transformer for all subsystems and a separate output Isolation Transformer for E&M supply to safeguard UPS and other systems like AFC, Telecom and Signalling. Failure of a single component shall not cause failure of the total UPS. The UPS shall be of the self-contained floor mounted, bottom entry, metal-clad type with front access.
- 3.2.2 The UPS shall be designed such that on restoration of the 415 V AC 3 phase input supply source after its failure, the load shall be transferred on to this input source only after a delay and verification that there are no spikes and that the voltage has stabilized.

~~2.2.6 Dual CAN Bus within frame & redundant CAN Bus between parallel systems to enable UPS parallel communication redundancy to be removed or inserted UPS in parallel configuration without need of transferring it to bypass mode.~~

~~2.2.7 UPS is configured for Green Mode to enable automatically transferring some modules to sleep mode in case of applied load is less than certain load percentage.~~

2.3 Availability Requirements

2.3.1 The Contractor shall submit calculations with reliability block diagrams for each sub-system to demonstrate the compliance with required availability figures. The availability calculation shall take all possible failure modes into consideration. The calculation shall be based on the Contractor's submitted equipment MTBF figures, MTTR figures and the configuration of each sub-system.

2.3.2 The Contractor shall predict the system failure rate or MTBF figures of each sub-system from the availability calculations.

2.3.3 Equipment duplication, hot-standby protection, parallel-run, path diversity, etc. shall be adopted whenever necessary and appropriate to meet the required availability.

2.3.4 Switchover between redundant equipment, or between redundant routings, shall occur automatically and immediately upon failure and shall be transparent to the users. Toggling in switchovers shall be prevented.

2.3.5 UPS system shall have an overall availability of better than 99.99%.

2.4 Maintainability Requirements

2.4.1 The System shall be designed such that the MTTR figures for restoring the operation of the System from fault condition shall not be more than four hours (all inclusive).

2.4.2 The MTTR figure shall be calculated from the individual equipment weighted by the failure rate of the equipment.

2.4.3 The MTTR figure shall be the total time calculated from the moment the occurrence of the fault at site is reported to the maintenance personnel to the time when the System is fully restored to normal operation. Time taken for the maintenance personnel to arrive at the site is included for the purpose of calculation of the MTTR figure.

2.4.4 All line replaceable items should normally not exceed the size and weight, which an average individual person can handle.

2.4.5 The System shall be suitably designed to minimize the need for frequent preventive maintenance.