RAWALPINDI DEVELOPMENT AUTHORITY
GOVERNMENT OF PAKISTAN

INTELLIGENT TRANSPORATION SYSTEM (ITS) REPORT

FOR

RAWALPINDI RING ROAD

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(ANNEXURE- B)

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INTRODUCTION:

The scope of work of ITS includes engineering, procurement, installation, testing and commissioning of the Intelligent Transportation System on turnkey basis in accordance with the functional description, system and equipment parameters listed herein. The Contractor shall be required to:

1) Conduct a detailed survey of Rawalpindi Ring Road (RRR) for relevant data collection and verification.
2) Prepare an Engineering Design Report for the Rawalpindi Ring Road (RRR) site giving, as a minimum, the following:
   a) The exact quantities and types of hardware required at Ring Road. Detailed listing shall be provided.
   b) Technical details and quantities of the hardware and software of the complete system.
   c) Detailed Construction Drawings
   d) As Built Drawings
   e) Details of any civil works required.
   f) Installation, testing and local commissioning procedures and methodology.
3) Provide control, monitoring and equipment along with supporting systems for Intelligent Transportation System which includes:
   a) Optic Fiber Cable (OFC)
   b) Routing and Switching
   c) Power and Telemetry
   d) Solar Power Supply System
   e) IP Based Video Surveillance System
   f) Electronic Toll Collection System
   g) Road Side Weather Information System
   h) Variable Message Sign (VMS)/Passenger Information System
   i) Traffic Control Center (TCC), Tier-III Primary Data Center and DR Data Center

The detailed functional requirements of the ITS systems are given hereunder:

1. OPTICAL FIBER CABLE (OFC)

Rawalpindi Ring Road (RRR) shall include 100% Fiber Optic Cable for Surveillance Pole Sites, Toll Stations, Control Room, Primary Data Center, DR data center and Service Areas etc. Number of Sites may be increased as per demand/request of Rawalpindi Development Authority (RDA) and other concerned stakeholders.

100% of the sites shall be connected through redundant fiber on both sides in a ring topology in such a way that if one fiber channel is broken then there would be an automatic availability of data stream through another channel or fiber link. OFC network shall be designed and implemented such that each camera shall be connected to at least two stations over optical fiber cable, and if one of the station is disconnected from the Control Room then the Pole Site cameras shall remain connected to the Control Room through adjacent/connected station(s). All of the stations shall be connected through optical fiber cable in an aggregate ring topology.

The cable and its associated networking infrastructure and accessories must meet the minimum bandwidth in accordance with the specification of cameras and network requirement (Routing and Switching).

Optical fiber Cable geometrical, mechanical and transmission attributes shall be according to ITUT-652D, IEC 60793 and IEC 60794. The Fiber shall be armored shielded 96 cores and shall be laid in HDPE pipe as per requirement. Laying of cable shall be supported with cabinets, Optical Distribution Frame (ODF) boxes and all other allied accessories. Joint box shall have minimum of IP-68 protection class and provided with Gasket type insulation. All cables shall be labeled or tagged with steel plate in each man hole/handhole.

The cable shall be free of material and manufacturing defects and it shall have dimensional uniformity. Each cable drum delivered shall include a test certificate from the manufacturer of the Cable. Contractor shall complete test of each drum delivered prior to installation to validate the manufacturer testing and record the test results.

All manholes/hand holes shall be made of concrete for high strength (>2400 PSI) and cover shall be labeled with “HSM-RRR” for easy identification, and each of these shall have sufficient number of duct holes for cable entry. All manholes/handholes shall be equipped with cable hangers/joint hangers for securing cable loop and joints and properly tagged with steel plate. All entries of manholes/handholes shall be properly sealed for water protection. At least 50 feet cable shall be coiled and racked at manholes.

The Contractor shall provide four number of HDPE ducts for fiber optic cable on the entire Ring Road. Two ducts shall be used for fiber optic cable and two will be used as spare. The size of HDPE dust shall be 40mm.

All cable installation/crossing through roads, bridges, drain, nullah and entry into Stations/Control Room building/DR DATA CENTER shall be compliant with TR-192 standard.

ONU

Optical network terminal pro ducts RLG8 04CWis launched for the CATVFTTH network construction. The CATV optical receiver of RLG804CW with technical features of low optical power received. RLG804CWPGON ONU support ITU G.984 series recommendations, support international standards and industry technical standards. With high reliability, better QoS guarantee, manageable, scalable, flexible networking features, can be satisfied with high - speed broadband access needs of the customer of broadcast. PON interface standards shall be ITU- T G.984.2/ITU - T G.984.3/ITU - TG.988 Class B+.

Optical Line Terminal (OLT)

OLT shall comply with ITU-T recommendations G.984.1, the G.984.2, G.984.5 and G.988. The GPON operating wavelengths shall be bidirectional 1550nm downstream and 1310nm upstream. The OLT shall support the pre-provisioning of ONT serial numbers and registration IDs and their associated ONT IDs. The OLT shall support DBA method and be capable of accommodating on the same PON a mix of status-reporting and non-status-reporting ONT.

1.1. OFC CIVIL ROUTE DESIGN

OFC Civil route design will be in AutoCAD format, and shall include:

- The construct route of this project
- The civil work type, e.g. ducts, attachment, etc.
- The location where the work is to be performed

- Legend showing the symbols used on the plans and the color-coding used to mark the plan
- Identify the proposed cable installation method on each plan sheet such as hand, machine trenching, or directional bore, attachments. G.I pipe. etc.
- Soil conditions
- Surface conditions e.g. concrete pavement, asphalt, tuff tiles. etc.
- Each 40 HDPE pipe shall accommodate one cable which should be pulled as per designed route,
- Coordination should be documented between the OFC to ensure that single points / paths of failure within the overall design have been identified

OFC SINGLE LINE DIAGRAM (SLD)

The OFC SLD should include:

- Sites/Pole name and ID
- Cable ID (Link ID)
- The HH number and location where has joint closure
- ODF rack fiber termination sequence
- The OFC cable type and cores
- Total OFC length between each two core sites
- The OFC length between each two adjacent joint
- The joint closures/ODF number and its location (coordinates)
- The splicing sequence of fiber in joints
- The link loss budget calculated at 1310nm and 1550nm for single mode fiber cable links.
- Indicate the length and type of cable proposed for installation

1.2. OFC LINK LOSS BUDGET CALCULATION

All components such as additional connectors, and splices along with cable attenuation, should be taken into account in calculating the loss. The maximum length of any optical path between two fiber optic repeaters must be calculated separately, and depends on the total loss in all components used in the path, including Optic Fiber Cable, optical connectors, and splices.

Required parameters to be included in the link losses calculation:

Link losses	dB (Maximum loss)
Cable loss (for standard G.652-D SMF,@1310nm)	0.4dB/km
Cable loss (for standard G.652-D SMF,@1550nm)	0.3dB/km
Splice loss (for standard SMF)	0.1dB
Connectors loss	0.5dB

1.3. EXCAVATION AND BACKFILLING

Cable installation along street/Road way shall strictly observe the following requirements:

When the cables route is at the outside of road/street, then the trench should reach to 1.5m except obstructed by underground services, pipelines, facilities, big rocks etc. In

case of terrain/soil issue the average shall be 1.5m. (Employer's approval required on all the obstruction which affecting depth to reach 1.5m).

Standard depth for conduit laid in the concreted area/pavement/footway/street way or roadway, routes in a pavement/footway should be 450mm and in a concreted area/roadway should be 600mm.

In order to maintain a smooth bottom of trench to avoid a bumpy pipe shape, the level of the bottom trench shall be concreted and maintained to a same depth level in the section between two adjacent manholes/handholes.

Excavation and backfilling duration should be less or equal to 3 days. Excavation notification to the other utilities operators should be done at least 5 days before commencement.

The area around the manholes/handhole shall be compacted. Upon final acceptance of the conduit/duct system all manholes/handholes shall be free of debris.

Place the barriers and road signs required by current laws during excavation works.

If the excavation must remain open or the road will be otherwise obstructed during the night or under low-visibility conditions, road signs shall be complemented by lighting devices of the color, shape and size stipulated by the traffic code.

Trenches should be backfilled to the original state and backfill shall be strong enough to support any kind of stresses.

Put an identification sign (marker) stated by these guidelines to illustrate the cable route.

The following operations shall be carried out after excavating the trench:

- Remove spoils from the sides of the excavation (Spoil must be transported to authorized disposal sites in accordance with local authority requirements)
- Remove adjacent paving materials which were damaged as a result of excavation

1.4. MANHOLE/HANDHOLE

Manholes/Handholes shall be covered by a lid which is water penetration protected on which the size and the depth of the Hand hole are written. Contractor shall provide details regarding the protection of handhole and a list of accessories to be used.

Manholes/handholes lids shall be labeled with text: "OFC-M" and the size. OFC-H/H Means Optical Fiber Cable –Hand hole, OFC-M/H Means Optical Fiber Cable –Man hole

Manholes/Handholes should be located outside of sidewalks and roadways if there is enough space for installation. In case there is no enough space outside and the man/hand hole installed on footway/road way edge, the top should level to ground surface.

Manhole/Handhole must be located a minimum of 2 meters off the edge of pedestrian way, and 3m from the off of the roadway if there is no space reserved for pedestrian way. In case of unavailability of the required clearance distance due to the soil or terrain condition; the request for shorter clearance shall be accompanied by pit test result approved by an engineer in charge of infrastructure from concerned institutions where the installation work will be conducted.

Manhole/Handhole shall not be located in the ditch line.

Manhole/Handhole can be pre-cast RCC structure. The Manhole/Handhole inner size is W*L*D=0.9M*0.9M*0.9M.

For Pre-cast Manhole/Handhole, below is the requirement:

- Concrete Ratio =1:1.5:3, target strength >2400 PSI
- Steel Bar=10 mm (min) used every 4 inches horizontally and vertically
- Thickness of Walls=4inches
- Entry holes should be made in advance in four walls
- Slab and cover should be same strength of material, which will be used for covering the hand hole.
- A factory serial number should be graved inside of the wall of hand hole
- Pre-cast hand hole can be transported by truck, and crane should be used to load/un-load. The hand hole pit should be leveled at the bottom.

1.5. LAYING PIPE

The pipe should be laid straight at the center of the trench. And the pipe should not twist, squeeze or break. Couplers are must when doing the pipe junction work.

All new duct installations shall be provided on the basis of the number of conduits required for cable installation based on a 40% fill ratio, an additional spare conduit shall be provided on each new route.

Conduits allocated for cable installation as part of the Central Control Room installation shall be sub-ducted to maximize cable installation density and to ensure ease of cable installation without snagging. Sub-duct sizes shall be calculated by the contractor based on the fiber optic design and submitted to the client for approval prior to installation. Approved sub-duct products include any combination of solid wall smooth bore sub-duct and flexible fabric multi-cell product. All conduits shall be provided with a draw rope in preparation for cable installation, the rope shall be replaced whenever a cable is installed. Instead of Sub duct, 40mm HDPE pipe multiway will be used as per the design.

1.6. WALL ATTACHMENT

When using duct type OFC, cable can be laid by wall attachment with PVC/ Corrugated PVC pipe/Corrugated GI pipe on the building / side wall to reach the site. The clamps should be fixed at every 1m interval. And at the turning point, corrugated PVC pipe is using to keep the bending diameter of OFC.

1.7. ENTRY INTO THE BUILDING

Ducts leading into buildings shall be sealed against the entry of gas, water and vermin.

1.8. PCC PROTECTION

Concrete mix ratio for PCC protection should be 1:2:4.

The thickness of PCC protection is 150mm over the pipe.

When doing the excavation, if the depth of HDPE pipe can only reach to 1/4-1/3 of the required depth due to underground services, PCC protection can be used to protect the pipe.

1.9. WARNING TAPE

Visible tape marking shall indicate the Contractor/project name and cable depth. It shall be placed along the trenches 30 cm below ground surface.

A suitable red PVC tape 0.35 mm thick and 100 mm wide shall be placed for indicating the excavators of the presence of optical fiber cable. The translation of “WARNING OF CABLE” in Urdu language and project name shall be printed on the tape in black letters 6 cm high and 2 cm wide at each one-meter interval. The color shall be red and tape shall be 200 to 250 meter in continuous length.

1.10. RUNWAY OF CABLE

The runway should be made by galvanized steel. The runway width is 350MM.

1.11. ROUTE MARKER

Surface markers to indicate the route of the cables shall be planted by the road sides. These markings shall be placed at intervals of between 100m to 300m.

The marker is made by concrete, its shape is rectangular parallelepiped, its size is 15cm*15cm*80cm. The concrete mix ratio is 1:2:4. The steel bar is grade 40 dia. = 5mm. The steel frame is made by 4 column steel bar and 4vertical rectangle steel.

The top 30cm of marker should be painted with RED painting. And a text of “RRR-” should be graved and painted with black color. The marker should be buried in 50cm depth; 30cm should be above the ground. The interval of marker should be 100-300m as per site actual situation.

1.12. OFC CABLE WORK

1.12.1. OPTICAL FIBER SPECIFICATIONS

All fiber optic cores shall be standards compliant ensuring splice compatibility with standards compliant fiber core of the same type from manufacturers. Layer of 3mm thickness Aramid Yarn shall be provided to cover the complete cable. All Optic Fiber Cables shall meet IEC 60793 and ITU-T G652-D standards.

PARAMETER	REQUIREMENT
Number of fiber	96
Attenuation coefficient at 1310 nm	≤ 0.35 dB/km
Attenuation coefficient at 1550 nm	≤ 0.20 dB/km
Optical discontinuities at 1310 and1550 nm	< 0.1 dB
Chromatic dispersion between 1285and 1330 nm	≤3.5 ps/nm·km
Chromatic dispersion at 1550	≤ 18 ps/nm· km
Cable cutoff wavelength	≤1260 nm
Installation Temperature	To be provided by the bidder
Operation Temperature	To be provided by the bidder
Minimum Bending Radius	To be provided by the bidder
Minimum Crush Resistance	To be provided by the bidder

1.12.2. CABLE SPECIFICATIONS

The cables must be circular in cross section and free from pinholes, joints, repairs and other defects. Materials used in the construction of the cable shall not affect the physical or optical properties of the fibers and shall be compatible with each other.

Cable sheath marking must include the manufacturer name, fiber optic core type, cable part number and meter marking. The text “RRR” should also printed every 1 meter. The format example is like below:

RRR- FACTORY NAME-G.652D-96F-1888M

Each fiber core must be distinguishable from other fiber cores by means of color coding ink visible throughout the design life of the cable (as Defined by TIA-598D).

When the OFC enter into room, the cable will be protected by corrugated G.I pipe.

Characteristics	96 Fiber
Number of Tubes	08
Number of Fiber per Tube	12
Final Cable Dia., mm	12.0 ±5%
Jelly Filled	Yes
Tensile Strength, Newton	3500
Cable Weight, Kg (Approx.) /Km	100
Tube material	PBT
Armoring	Corrugated steel plate
Filler material	Medium density polyethylene
Moisture barrier	Both side polyester coated water swell able tape
CSM type	Fiber Reinforced Plastic
Aramid Yarn	Yes
Strength member	CSM
Outer sheathing material	High Density Polyethylene
Sheath thickness	2-mm +/- 10% average, min. at any point +/- 20%

Contractor shall submit Factory Acceptance Test as per IEC 60794, Fluid penetration test carried out by the Contractor for offered Optical Fiber Cable. Contractor shall submit detail of each test, Splicing Method (there should be no factory splicing) and cable installation practice. as per the relevant standards.

2. Following Factory Acceptance Test shall be carried out by the Contractor for offered Optical Fiber Cable. Contractor shall submit detail of each test as per the following standards.

Name of test	Stander Name
Chromatic dispersion CD	(IEC 60794-1-42)
Repeated Bending Test	(IEC 60794-1-48)
Cut-off	(IEC 60794-1-44)
Mode Field Diameter MFD	(IEC 60794-1-45)
Bend Loss Testing Machine	(IEC 60794-1-2-47)
Spectral Attenuation	(IEC 60794-1-2-40)

Fiber Curl	(IEC 60794-1-34)
Fiber Geometry	(IEC 60794-1-20/21)
Torsion Test	(IEC 60794-1-2-E7)
Impact Test	(IEC 60794-1-2-E4)
Bend /winding Test	(IEC 60794-1-2-E11)
Flexing Test	(IEC 60794-1-2-E8)
Vibration Test	(IEC 60794-1-2-E19)
Abrasion Test	(IEC 60794-1-2-E2)
Kink Test	(IEC 60794-1-2-E10)
Minimum Bending Test	(IEC 60794-1-2-E11)
Temperature Cycling Test	(IEC 60794-1-2-E11)
Water Penetration Test	(IEC 60794-1-F1)

2.1.1.1. The Fiber Optic Cable Origin and Manufacturer shall be at

a) USA
b) Europe
c) Pakistan

The Fiber Optic Cable shall be designed, supplied, manufactured and assembled at the above countries only.

The Original Equipment Manufacturers (OEM) ITS Systems, the Contractor shall clearly identify the following;

1) Brand of the equipment,
2) OEM Headquarter country
3) Place of manufacturing
4) Distributer / Partner in Pakistan who shall provide local maintenance and Operation assistance.

The details reference shall include at least (but not limited to)

- Company name,
- Address in Pakistan,
- Contact persons,
- Phone numbers,
- Valid Email addresses

Failure to comply with this requirement will result in rejection of the manufacturers. The Contractor shall clearly mention in his bid the origin of the equipment that he is offering.

The manufacturer shall have a minimum of 20 year's experience in the design, manufacturing of fiber optic cable.

1) The raw material of Fiber Optic Cable certificates and Contract shall be provided that all material of fiber optic cable is sourced from foreign countries and detailed hereunder:
   - Optical fiber glass : Corning or Fujikura
2) The manufacturer shall have supplied and installed the Fiber Optic Cable to international country. The International Performance /End Used Certificate shall be provided.

3) The manufacturer shall have fully equipped state of the art equipment in the optical fiber test labs for conducting optical/mechanical tests. Cable's test laboratory shall affiliate from ILAC & CNAS .or other international recognize laboratory, certificate shall be provided.

4) The manufacturer shall have the list of equipment /machines installed in the lab for testing shall have hereunder:

Detail of OFC Testing Equipment					
Optical Test Equipment					
S. No	**Tests**	**Standard**	**Company**	**Model**	**Description**
1	OTDR				
2	Fusion Splicer				
3	PMD				
4	Mechanical Splicer				
Mechanical Tests					
S. No	**Tests**	**Standard**	**Equipment/Company**		
1	Tensile Test	(IEC 60794-1-2-E1)			
2	Crush Test	(IEC 60794-1-2-E3)			
3	Repeated Bending Test	(IEC 60794-1-2-E6)			
4	Torsion Test	(IEC 60794-1-2-E7)			
5	Impact Test	(IEC 60794-1-2-E4)			
6	Bend /winding Test	(IEC 60794-1-2-E11)			
7	Flexing Test	(IEC 60794-1-2-E8)			
8	Vibration Test	(IEC 60794-1-2-E19)			
9	Abrasion Test	(IEC 60794-1-2-E2)			
10	Kink Test	(IEC 60794-1-2-E10)			
11	Minimum	(IEC 60794-1-2-E11)			

	Bending Test		
12	Steel Tape Continuity test	---	
13	Temperature Cycling Test	(IEC 60794-1-2-E11)	
14	Water Penetration Test	(IEC 60794-1-F1)	

Optical Tests			
S. No	**Tests**	**Standard**	**Equipment/Company**
1	Chromatic Dispersion CD	(IEC 60794-1-42)	
2	Polarization Mode Dispersion (PMD)	(IEC 60794-1-48)	
3	Cut-off Wavelength	(IEC 60794-1-44)	
4	Mode Field Diameter MFD	(IEC 60794-1-45)	
5	Bend Loss Testing Machine	(IEC 60794-1-47)	
6	Spectral Attenuation	(IEC 60794-1-40)	
7	Fiber Curl	(IEC 60794-1-34)	
8	Fiber Geometry	(IEC 60794-1-20/21)	

5) The manufacturer shall have the facilities of Mechanical Test Labs for testing shall be fully Automated for Tensile Test, Repeated Bending test, Minimum Bending test, Torsion, Impact, Temperature cycle test, Crush test , Kink test, Flexing test ,Winding test ,Vibration test, Abrasion test and water Penetration tests. Optical Lab shall be attenuation, Chromatic Dispersion, cutoff wavelength, Geometry, Fiber Curl and PMD

6) The manufacturer shall have Calibration certificates of testing equipment and shall be provided.

7) The manufacturer shall be certified from ISO 9001:2008 for Quality Management System & ISO 14001:2004 for Environmental Management System. Certificates shall be provided.

2.1.2. OFC CABLE LAYING

Any OFC joint shall be housed inside the Manhole/Handhole.

The pulling of the cable shall be hand assisted at each Manhole/Handhole. The cable shall not be crushed or forced around a sharp corner. Sufficient slack shall be left at each end of the cable to allow proper cable termination. In the joint hand hole, 10M slack should be looped on each side. In normal Manhole/Handhole where there is no joint, 2M slack should be kept in each hand hole.

All ducts shall be installed with a pulling rope when installed. A replacement rope shall be installed whenever a new cable is installed to the duct.

2.1.3. OFC CABLE JOINTING

Check the line sequence of optical fiber, according with A end to joint B end type to do junction.

The junction environment must be clean, the junction part and tool, material also must be clean, to ensure the junction quality and sealing performance of sleeve.

In optical preparing, strictly prohibit using blade to wipe off coat or use fire to make end section. Professional peel tools and un-cut tools should be provided.

For jelly filled type optical cable, it should use special cleanser to wipe off stuff, strictly prohibit using petrol to clean it.

It should accord with installation technique of junction sleeve to denude cable jacket, and not damage other parts of cable.

2.1.4. OFC CABLE TERMINATION IN CABINET

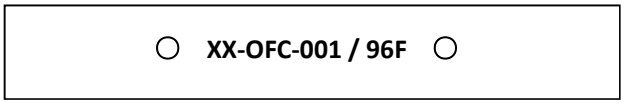
At the end node, the cable need terminate in the cabinet as per the installation manual. The cable should be fixed in the entry. If the cabinet supports un-cut method, the un-cut tubes/fibers should be properly looped.

2.1.5. OFC TAGGING

Every cable shall be individually labeled in every chamber by the Cable Contractor in accordance with the administration scheme identifying origin, destination and unique cable reference.

The cable shall be tagged at each Manhole/Handhole and chamber. The label should be made by white PVC material. Its size is not less than10mm*80mm*2mm. And the label text format is “XX- Cable ID SR.NO. /fiber cores” (XX = Project name) should be printed with black ink. The label should have two small holes on both end and will be tied on the cable with cable tie. Each cable’s start and end point with ID and cable type will be provided in SLD.

Below is an example format of tagging:



2.1.6. ODF FIBER TERMINATION

The cable should be terminated on 96 Port ODF with coupler pigtail and patch cord as per design.

2.1.7. OFC CABLE TESTING

After OFC cable laid and terminated, OTDR testing and OLTS testing should be performed for all the terminated fiber cores. The test should be performed at 1310nm and 1150nm in bi-direction. The test result should be recorded in a test report form.

2.1.8. OFC ACCEPTANCE PROCEDURE

2.1.8.1. OFC CIVIL WORK COMPLETION INSPECTION

The installation project should be considered as completed after validation of inspection report.

Routine on-site inspection and testing should be performed during the construction especially for those concealed work which can't be inspected after completion of the civil work.

For OFC civil work, OFC Civil Work Completion Inspection/Test can be performed during civil work for every Hand hole to hand hole distance, usually it is about 100-300m. OFC civil work checklist should be countersigned on site after inspection.

Below are the routine civil work inspection criteria:

1) The route is as per design/route plan
2) Trench depth is as per specification
3) Pipes/warning tape is as per specification
4) Man/hand hole is as per specification

The Contractor shall submit work process (work flow) and the inspection checklists.

2.1.8.2. AS-BUILT SITE VISIT

After completion of each section, after installation completion either by trench or trenchless technique, the Contractor should prepare a site visit with Employer in order to check the excavated area status before commencing the following section and each visit should be accompanied by its report. If the work is composed in sections, the permit of following section shall be given by Employer after previous section site visit report acceptance. The site visit by the Contractor shall consist with conformance to the engineering plans, codes, guidelines, and general accuracy. It should be made at the completion of each section including the last section of installation works.

The routine on-site inspection/test checklist shall be compiled as support documents for this As-Built site visit. The site visit of the constructed areas shall focus on the following:

- Restoration has been accomplished.
- Permanent markers have been installed immediately beside the cables.
- Road bores, if used, are properly completed and will not collapse a portion of the road.
- Debris and trash have been removed from the site.
- Other instructions specific to the installation have been completed to the drawing's specifications and to the related institutions requirements.

As-Built site visit report shall be countersigned after the As-Built site visit for each section.

In case of unsuccessful installation works, all non-accomplished tasks indicated by site visit team must be handled. It is the responsibility of the Contractor to immediately respond to non-accomplished items and complete those items. In case of noncompliance with these

guidelines, the Employer may issue an enforcement notice to remedy the failure within a specific period of time.

2.1.8.3. FINAL AS-BUILT REPORTING

The as-built drawings and documents shall identify the actual route and other information such as the cable/pipe/hand hole type and length/dimensions. These drawings and documents are typically the construction detail sheets/drawings that have been corrected to reflect any changes during construction. As-Built drawing can follow the same format as the design drawings. And As-built drawing shall record all deviations, removals and additions with respect to the original scope.

Referring to the schedule agreed, the Contractor shall provide an accomplishment report to the employer within 5 working days and an as-built documentation containing the following information not later than 15 working days from the accomplishment of the installation works:

- Position of the installed pipes
- locations of installed cables
- Soil conditions
- Network loss link budget
- OTDR traces for each link, soft copy by USB drive or e-mail. (the format of this trace should be same as the file format copy out from the OTDR instruments)

After the submission, Employer should verify all the documents/drawing and grant takeover certification for the completed sections. Takeover certification document should include below information:

- Civil Section / OFC Link name and ID
- Section route length
- Section OFC length
- Contract Number
- Employer full name
- Signatures
- Date

3. ROUTING and SWITCHING

Routing/Switching equipment shall be installed at each of the Pole Site, Toll Station, Service Area, Primary Data Center, DR Data Center and Entry/Exit point. Routing and Switching equipment shall support Multiprotocol Label Switching (MPLS) and Virtual Private Network (VPN). The equipment shall have Ring protection protocols and provide support of static routing and dynamic routing protocols i.e. Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Intermediate System to Intermediate System (ISIS), Interior Gateway Protocol (IGP), Border Gateway Protocol (BGP), Bidirectional Forwarding Detection (BFD) and other protocols like Virtual Router Redundancy Protocol (VRRP), IPv4/IPv6 Policy-based routing, IPv4/IPv6 Routing policy, IPv4v6 Dual stack. All field switches and routers used in the project shall be robust structure with no need for adaptors or media-convertors for copper cable.

The throughput of the Layer-3 devices must be sufficient to cater the data needs and traffic of all Cameras, Telemetry data, VOIP/Video data, and all systems of ITS. The equipment shall support Port-based VLAN, MAC-based VLAN, Protocol-based VLAN, Subnet-based VLAN, QinQ and selective QinQ VLAN mapping, Voice VLAN and GVRP. The equipment shall support STP/RSTP/MSTP, RRPP and Smart Link. A NMS (Network management System) must be given to monitor traffic all over the Rawalpindi Ring Road (RRR) network.

3.1. CORE SWITCH

The Core Network shall have ‘redundancy’, ‘self-healing’ and ‘self-recovery’ capabilities. The traffic profile (e.g. bandwidth, QoS tolerance, redundancy, etc.) shall be determined and documented in the design for each node. The Network aggregate bandwidth shall be sufficient to meet the bandwidth requirements of the multiple video streaming of each of the Pole Cameras, Telemetry data, all systems of ITS at each node.

The network shall be configured accordingly to ensure monitoring of traffic and optimum performance of the supported systems. The typical layout and Network architecture shall be demonstrated, including the key components and their function, their connectivity (logical and physical) and any interfaces/dependencies with other systems. The core switches shall have the ability to cater to the data needs of the backbone network and shall be in 1+1 configuration. It shall be ensured that there is redundancy in Core Routers, Firewalls and Core Switching equipment including power-supplies at the respective network levels. The Core Switch shall have the following parameters;

The Core Switch shall provides full Layer 2 and Layer 3 functionality for carrier networks and data centers. The Core Switch shall meets the DC requirements for Top-of-Rack and End-of-Row switches and requirements of service provider for aggregation and backbone networks, providing high performance and cost-effective solution.

The Core Switch shall have non-blocking architecture guarantees lossless packet forwarding at wire speed with minimum and predictable delays for all types of traffic. The front-to-back cooling provides effective cooldown in modern data centers. The redundant and hot-swappable fans and AC/DC power supplies with advanced hardware monitoring functions provide high reliability and uninterrupted services.

Core Switch with hot swappable redundant power supply having with the Following:

a) Interfaces: 48x10GBASE-R(SFP+)/1000BASE-X (SFP) 4x40GBASE-SR4/LR4 (QSFP)
b) Console port: RS232/RJ-45

c) Bandwidth: 9 Tbps
d) Buffer memory: 9 MB
e) MAC table: 128K
f) VLAN table: 4094
g) SQinQ rules: 4094
h) Quality of Service (QoS) : 7 queues
i) TCAM 2K Ingress, : 1K Egress
j) L2 Multicast groups: 2K
k) VRRP routers: 20
l) ARP table: 6K
m) L3 interfaces: 128
n) Virtual Loopback interfaces: 64
o) Link Aggregation Groups (LAG) 64, 32 ports per LAG
p) MSTP: 32
q) Jumbo frames: 12270 bytes
r) IPv4 Unicast routes: 16K
s) IPv6 Unicast routes 8K
t) Stacking up to 8 devices
u) Power supply
   - AC power: 220 V+-20%
   - DC power: -36.-72V
   - Power supply options:
   - 1 AC/DC power supply
   - 2 AC/DC hot-swappable power sources
v) Max power consumption 150 W
w) Cooling Front-to-Back, 4 fans
x) Operating temperature from -0° to +50°C
y) Operating humidity 80%
z) Storage temperature from -40° to +70°C

3.2. LAYER-3 ACCESS SWITCH

All Layer-3 Switch must support SNMPv1/v2c/v3, Telnet, CLI, Web Management and automatic configuration. The proposed switches to be deployed in the field shall be suitable to operate under the environmental conditions of temperature -20°C to 50°C and relative humidity ≤95%.

The Access Switches to be Supplied Shall Comply with the following:

a) 1000 Base –T (RJ-45) Ports(PoE / PoE+) : 24 Ports
b) 1000 Base-X (SFP) : 4 Ports
c) Console Port : RS-232/RJ-45
d) Bandwidth : 128 Gbps
e) Packet forwarding rate(64B) : 93.1Mpps
f) Buffer memory : 12 Mb
g) RAM (DDR3) : 512 MB
h) ROM (RAW HAND) : 512 MB
i) MAC table : 16K
j) VLAN table : 4k
k) L2 Multicast groups : 2K
l) Quality of Services (QoS) : 8 deg. queues per port
m) TCAM for routing : 1024xIPv4,
n) ARP table1 : 1k
o) Link aggregation Group (LAG) : 16, upto 8 ports per LAG
p) Maximum size of ECMP group : 8

q) Maximum Jumbo – frames size : 10240 B
r) Stacking : 08 devices
s) Max power consumption : 410W including (PoE)
t) L3 functions:
- Static IP routes
- Dynamic routing protocols RIPv2, OSPFv2, OSPFv3
- Address Resolution Protocol (ARP)
- VRRP
- PIM SM, PIM DM, IGMP Proxy
- ECMP Load Balancing
- IP Unnumbered

u) OAM
- IEEE 802.3ah Ethernet OAM
- Dying Gasp
- IEEE 802.1ag Connectivity Fault Management (CFM)
- IEEE 802.3ah Unidirectional Link Detection (UDLD)

v) Security functions
- DHCP Snooping
- DHCP Option 82
- IP Source Guard
- Dynamic ARP Inspection
- sFlow
- MAC-based authentication, Port Security, Static MAC entries
- Port-based authentication IEEE 802.1x
- Guest VLAN1
- DoS attack prevention
- Traffic segmentation
- Protection against non-authorized DHCP servers
- DHCP clients filtering
- BPDU attacks prevention
- NetBIOS/NetBEUI filtering
- PPPoE Intermediate Agent

w) Monitoring functions
- Statistics on interfaces
- RMON/SMON
- CPU utilization monitoring per tasks and per traffic type
- RAM utilization monitoring
- Temperature monitoring
- TCAM utilization monitoring

3.3. INDUSTRIAL GRADE ACCESS 8 PORT SWITCH

Industrial switches shall be provided to organize secure fault-tolerant networks on sites with high requirements of temperature, vibrations, mechanical impact, etc. The switches shall have 10/100/1000BASE-T with PoE/PoE+1 support and Combo ports of 10/100/1000BASE-T/1000BASE-FX for fiber or cooper cable. Features of 8 port POE access switch shall be as follows:

a) 8x 10/100/1000BASE-T (PoE /PoE+, RJ-45),
b) 2 x Ports : Combo 10/100/1000BASE-T (RJ-45)
c) 2 x Ports : 1000BASE-X/100BASE-FX
d) Console Port : RS-232 (RJ-45)

e) Protocols and functions : SNMPv1/v2c/v3, DHCP Server/Client, DHCP Option 66/67/82, BootP, TFTP, HTTP, HTTPS,Telnet, SSH, Syslog, IPv6, Port Security, IP Source Guard,
f) Port Monitor
g) Bandwidth : 20 Gbps
h) Throughput for 64 bytes : 14 MPPS
i) Quality of Services (QoS) : 4K
j) MAC table : 16K
k) Buffer memory : 512MB
l) RAM (DDR3) : 512 MB
m) ROM (RAW HAND: 512 MB
n) TCAM : 3K
o) Jumbo frame size : 10240 bytes
p) Power Supply voltage : PoE enabled : 45 upto 57 VDC
q) Power budget PoE : 240W (for 802.3at standard 54 upto 56 VDC
r) Alarm relay : 1 alarm reply output: 1 A, 24 VDC
s) Device Housing : Metal, IP-30 rating
t) Operating humidity : 5 – 95%
u) Operating temperature: -40°to 75°

3.4. FIREWALL

The firewall deployed in the core network shall have ASIC/RISC based CPU and support UTM features including firewall, IPS, antivirus, anti-spam, Proxy based web filtering and content filtering services with lifetime subscription. Entire network must be protected by hardware-based firewalls for inbound and outbound traffic. The firewall shall be able to monitor/filter and comply with the traffic of complete core network e.g. NADRA, GIS, ISPs, or other LEAs provisional databases, etc. The firewall shall have minimum available ports including additional ports to monitor/cater to the data of the core network and future requirements. The firewall shall support SNMP v1/v2/v3, TCP/IP-based, SNMP v2 MIB protocols and Telnet CLI, SNMP v1, v2c, v3 and Web-Based Management. It shall support VPN technologies like IPSec VPN, SSL VPN, L2TP VPN, MPLS VPN and GRE. Defense against DoS attacks, such as the SYN flood and UDP flood attacks, Static Routing, Policy based routing, Brute force attack mitigation, Zone-based IP spoofing, Data leak prevention. At least 60 million URLs must be identified..

4. INTERNET FACILITY

Internet Facility shall be provided for service area, toll collection, data center through Wi-Fi Apps for public. The Wi-Fi system shall facilitate at each service area at main toll collection, Persons at normal toll collection and persons at data center.

4.1. INDOOR ACCESS POINT

Indoor Access Point shall provide high-speed, safe, accessible and easy to-use wireless network which shall combines many features and services needed for corporate clients. Indoor Access Point shall use for large number of users and high traffic (office, etc.). Indoor Access Point shall have Wireless Wi-Fi connection with the support of the standard IEEE 802.11ac Access point WEP-12ac delivers transfer speed up to 1 Gbit/s. The device shall have key advantages of technology BEAMFORMING - to dynamically change the radiation pattern of antennas, so that optimum coverage hotspot adjusts to the current location of the user and have six dual-band antennas and large radius coverage (up to 200 m) make it possible to access point for organizations of the corporate network. Indoor Access Point shall provide Security for corporate environment, modern technology authentication and encryption provide protection and security of personal data of the corporate environment. The Indoor Access Point shall have High-performance solution on the basis of Broadcom chipset Support 802.11 ac (5G Wi-Fi) Power: PoE, leased lines Work in a cluster without a dedicated server (up to 32 devices) Seamless roaming Modern means of authentication and encryption Service up to 400 users

- Interface 2x 10/100/1000Base-T ports (RJ-45) PoE/PoE+
- Console RS232
- Maximum transmitter power up to 18 dBm
- Radius coverage up to 200 m
- NAND flash 128 MB
- RAM DDR3 256
- Power: - PoE
- DC 48V/54V (IEEE 802.3at) 12V
- Power consumption max 16 W
- Operating temperature +5 to +40 °C
- Humidity: upto 90%

4.2. OUTDOOR ACCESS POINT

The Wi-Fi WLAN access point shall provide high-performance and safe wireless connection that combines numerous features and services absolutely necessary for convenient network access in crowded areas. Wi-Fi WLAN access point shall proper solution for organization of wireless networks in various climatic conditions in a wide range of operating temperatures and high humidity and provides an optimal platform for communication networks organization in suburban settlements and remote locations. The wireless access point shall have flexible solution that allows you to change the network coverage in order to increase the quantity of serviced mobile devices. Due to high-performance hardware platform, scalability features, and understandable interface, it shall possible to set up wireless IT infrastructure simply and fast.

The Wi-Fi WLAN access point shall have 1300 Mbps (5GHz) + 450 Mbps (2.4 GHz) data rate as it supports IEEE 802.11n/ac standards. Furthermore, the WOP-2ac supports MIMO technology and has omnidirectional antennas that makes it a universal solution for public networks organization.
The Wi-Fi WLAN access point provides secure connection due to the support of up-to-date authentication technologies. Particularly, it uses a dynamic key that is unique for each mobile device that interacts with Wi-Fi WLAN access point.
To ensure a stable and uninterrupted operation, the device shall equipped with high-performance Broadcom chipsets providing top data processing rates.
The Wi-Fi WLAN access point shall have PoE + technology to install the equipment virtually anywhere, regardless of the power supply location, reduce total cost by discarding power cables and perform the installation easier and faster.
The Wi-Fi WLAN access point shall have the Following features:

a) Dual band Wi-Fi 802.11ac
b) Frequency range: 2412–2472 MHz, 4900–5850 MHz
c) Data Transfer rate: 802.11ac: 1300 Mbps
d) 3x3 MIMO support
e) 2 x Ethernet 10/100/1000 Base-T (RJ-45)
f) 1 x 100/1000BASE-X (SFP) optionally
g) 6 x N – type (female) for external antennas (Omni, sector rod, etc.)
h) Console (RJ-45)
i) IEEE 802.11 a/b/g/n/ac standard support
j) 32 virtual access points
k) Automatic speed negotiation, duplex mode negotiation, and MDI/MDI-X switch-over
l) VLAN, 802.1X authentication, DHCP client, LLDP, ACL and Ipv6 support
m) Power consumption below 20W
n) 128MB NAND Flash
o) 256MB RAM DDR3
p) Power supply: PoE+ 48V/54V (IEEE 802.3at-2009) 48V DC
q) Operating temperature from -40 C to +60 C

4.3. NETWORK AND WIRELESS AP CONTROLLER/ AGGREGATION POINT

4.3.1. CAPACITY PERFORMANCE:

The Controller/aggregation point should manage both Access Point and Network switch on single platform.

- higher Access Points
- Higher Switches
- higher Concurrent user
- Support 40G aggregated throughput
- 4x gigabit ports and 4x 10G SFP+ ports
- IPv6 support

4.3.2. ARCHITECTURE:

The Wireless Controller must support a distributed forwarding/local breakout architecture in which only client authentication is tunneled to the centralized controller; all client data traffic is forwarded directly on towards its destination via the clients default gateway.

- Specify any loss of functionality, caveats or loss of capacity/performance is exhibited by the solution in this distributed forwarding mode
- On per WLAN (SSID) basis there must be an option to tunnel traffic to the controller either unencrypted or encrypted format.

4.3.3. ACCESS CONTROL LIST (ACL)

The systems must be capable of identifying device host OS type and the host name. Further:

- It should be able to utilize the host OS information to provide policy based access such as allow/deny access, rate limit and assign to VLAN
- Controller should support ACL of layer 2, layer 3 and Layer 4
- Channel Selection and Meshing
- Device should support automatic channel adjustment on the Basis of Background scanning and Channel Throughput
- Device should support automatic transmits power adjustment on each AP to achieve optimal performance
- The controller should provide a captive portal in order to authenticate Guest users that are not part of the organization via a Guest pass key
- Provide a web-based application that allows non-technical staff to create Guest passes that are valid for a time limited duration
- Allow the IT Administrator to view and delete individual Guest passes
- Allow for batch generation of Guest passes

4.3.4. REDUNDANCY

The controller must support a High Availability (HA) mode with cluster configuration

- N+1 cluster configuration support. Both local and co-located and geo-separated
- Supports linearly scaling the capacity by just adding more Controller to a cluster without operationally impacting the existing Controller in operation

Controller must support redundant power supplies and with redundant fans.

4.3.5. AUTHENTICATION

Controller should support following Authentication mechanism:

a. 802.1x
b. MAC-Address
c. External server i.e. LDAP, Active Directory and RADIUS sever

5. POWER AND TELEMETRY

Power Telemetry solution shall be designed using host controller RTOS (Real Time Operating System) or Linux OS. It shall be compatible with industry standard NMS (Network Management System) using Simple Network Management Protocol (SNMP) / Management Information Base (MIB), and shall be independent from Routers/Switches. The telemetry units shall be able to communicate with Control Room to provide the status of site equipment (Switches/Routers), network health, any site intrusion (pole climbing), power failure, environmental conditions and any other abnormality for immediate remedy. Monitoring sensors such as Temperature, Humidity, Transducers (Current, Voltage, Power factor, Frequency), Anti climbing, Door Opening, etc. shall be integrated in the Telemetry System. All the sensors shall be connected to Remote Terminal Unit (RTU) using an industry standard physical interface i.e. voltages such as 4–20mA or 0-5VDC or 0–10VDC. Dash boards shall be provided at Control Room to monitor the telemetry values of all the sites, and which shall be configurable to group together various sensors values. Alarms shall be logged in the respective logger and it shall be possible to view these group or zone wise. A summary alarm window shall be provided for all the city locations showing any current alarm in colored animated state.

RTU shall be capable to handle all I/Os mentioned above having sufficient programmable capacity including 20% spare. RTUs shall have the provision of deploying Ethernet, TCP/RS485/RS232 ports or Modbus RTU/ASCII Protocols.

All the critical elements such as the Primary Data Center must have voltage stabilization. Primary Data Center and emergency control room must be 3-tier which includes National power (Utility Power from Distribution Company), UPS and Generators (DG Set). Power at Pole sites shall be 2-tier which shall include Solar and hybrid UPS.

The diesel generator shall automatically shut down under following conditions:

- Low Oil Pressure
- High Engine Temperature
- Low Fuel Level
- Over/Under Speed
- Battery Charge Fail
- Earthing studs need to be provided.

The diesel generator shall have super silenced acoustic canopy. Diesel generators housing shall have fire detection system suitable for use in an area containing diesel fuel. The fire detection system shall cut off the fuel supply from the tank in the event of a fire. The fire detection system shall operate an alarm system.

5.1. HYBRID UNINTERRUPTED POWER SUPPLY SYSTEM (UPS)

Hybrid AC and Solar UPS of Twenty-four-hour backup shall be provided to power all the equipment and systems.

- It shall comprise; redundant chargers; battery bank; redundant invertors. The switch over from mains to the UPS supply and vice versa shall be accomplished in less than 5 msec.

- The Hybrid UPS shall be floor mounted; self-contained and metal clad and shall be suitable for supplying a nonlinear load.
- It shall be possible to open the enclosure front door when the unit is in use without exposing any live contact to touch.
- The Hybrid UPS shall be an on-line type incorporating a six pulse rectifier and pulse width modulation inverter technology with microprocessor control. It shall incorporate a static bypass switch which shall operate in the event of UPS failure, overload or manual initiation in order to transfer the output supply to mains without disturbance to the output supply.
- The Hybrid UPS shall incorporate a dc under voltage trip circuit to electronically trip the UPS output in order to protect the batteries.
- The output of the inverter shall be a sine wave having less than 2% THD for linear loads and less than 4% for 50% nonlinear load. It shall be suitable for load power factors 0.7 lag to 0.9 lead.
- The unit shall have a dynamic response such that a 100% step load causes an output voltage transient of less than ± 4% with a recovery time of less than 4 ms.
- For three phase output units the output voltage shall not vary by more than ± 1% for an unbalance of 10%.
- The load crest factor shall not be less than 3: 1.
- The efficiency at full load and 0.8 power factor shall be greater than 88%.
- The unit shall incorporate a monitoring and diagnostics system to provide an audible alarm to provide warnings and fault indication.
- The following parameters shall be monitored:
  a) Inverter output voltage
  b) Battery voltage
  c) Static bypass voltage
  d) Output current
  e) Inverter output frequency
  f) Available battery bridging time at rated load
  g) Available battery bridging time depending on actual load.
  h) Indicators to indicate
  i) UPS status
  j) UPS alarm conditions
- It shall be possible for operations and maintenance personnel to determine the cause of UPS failure by viewing a fault annunciation display or by interrogation of a ‘user friendly’ integral key pad and display unit.
- The UPS shall have an emergency power off facility. This shall be operable both locally and remotely. A 24 V dc emergency shutdown relay shall be provided to accept the remote shut down signal.
- The UPS shall be required to be manually reset after operation of the emergency shutdown.
- The UPS shall provide a volt free contact output to indicate:

a) Warning, i.e. low battery capacity
b) Fault
c) Static bypass in use.

- The UPS shall have an overload capacity of 150% for 30 seconds and shall be protected in the event of a short circuit of the output.
- The batteries shall be housed, either within the UPS enclosure or within a separate matching battery cubicle suitable for location adjacent to the UPS.
- The batteries shall be of the maintenance free sealed for life lead acid type.
- Batteries shall be contained within translucent impact resistant flame retardant polypropylene cases. They shall be designed for low maintenance and shall have a life in service of at least 10 years.
- The cells shall be arranged in tiers to enable a rapid visual check and access for maintenance. Terminals shall be shrouded to prevent accidental contact. The battery enclosure shall be corrosion resistant and ventilated to prevent the buildup of gases.
- Battery sizing calculations shall be based on Standard IEEE 485
- The battery installation shall be supplied complete with all tools etc. necessary for the safe and efficient maintenance of the batteries.
- Warning notices shall be provided for wall mounting to warn of the presence of charge gases.
- The battery supply to the UPS shall be via a fused load break switch disconnected circuit breaker.
- The battery recharge time to 90% of full charge shall be approximately two times the discharge time at full load. Battery charge time shall be optimized with higher charge currents and multi-stage charge methods.

The Contractor shall provide all associated cables including power cable for UPS system.

The Contractor shall design Uninterrupted Power Supply (UPS) for complete ELV system and Co-ordinate the system engineering with electrical power supply, ELV, Communication Rack, Patch Panel etc. Detailed shop drawings shall be submitted before commencement of work for approval of the consultant. Shop drawings shall include all horizontal and vertical cablings layouts, IT room layouts for communication racks etc.

Redundant UPS shall have the following specifications:

SYSTEM INPUT:

- Nominal voltage: 380/400/415Vac, (3Ph+N+PE)
- Operating voltage range: 208~478Vac for half load; 305~478Va c for full load
- Operating frequency range: 40~70Hz
- Power factor: ≥0.99
- Harmonic distortion (THD_i): 2% (100% non-linear load)
- Bypass voltage range: 380Vac Maximum voltage: +25%(optional +10%, +15%, +20%)
- Minimum Voltage: -45% (optional -20%, -30%)
- Power walk-in/soft-start: Shall be linear from 0 to 100 % of the load over a 15-second period.
- Bypass frequency range: Frequency synchronize tracing range: ±10%

- Generator access: Support

SYSTEM OUTPUT:

- Rated voltage: 220/230Vac
- Power factor: 0.8~0.9
- Voltage regulation: ±1%
- Crest factor: 3:1
- Harmonic distortion (THD_v): ≤2% with linear load
- Efficiency: ≥93.50%

Battery:

- Battery voltage: ±96/±108/±120Vdc; Battery quantity(optional)
- Charging current (A): 60A (Max.)
- Rechargeable VRLA battery with capacity of l2V65Ah will be deployed in separate power room;

SYSTEM FEATURES:

- Transfer time: Utility to battery:0ms; Utility to bypass:0ms

OVERLOAD:

- Battery Mode: Load≤110%: last 30S, ≤125%: last 1S,≤150%: last 200ms,≥150% shut down UPS immediately
- By-Pass Mode: Breaker (10kVA:20A / 15kVA:32A / 20kVA:40A)
- Short circuit: Hold whole system
- Noise suppression: Complies with EN62040-2

ENVIRONMENT:

- Operating temperature: 0～40℃
- Storage temperature: -25～55℃
- Humidity range: 0～95% (Non-condensing)
- Altitude: <1500m. When >1500m, de-rating power for use
- Noise level: <65dB

PHYSICAL:

The modular UPS system shall use built-in, concentrated and hot swappable bypass.

Safety: IEC/EN62040-1, IEC/EN60950-1

MONITORING:

1) The UPS shall be provided with Communication interface: PS cabinet: RS232, RS485, Dry contact, Intelligent slot x 2(SNMP card, Relay card and various alarm signal.
2) The following minimum set of alarm condition shall be available: Real-time monitoring system working status: normal mode battery mode/bypass mode, overload, low battery voltage, battery discharging status, AC failure, record of system failure and running status. Acquire and store system running parameters: main input voltage. Bypass input voltage, output circuit, output frequency, battery voltage, charge/discharge circuit.
3) UPS should send audible and visual alarm when protective function is activated. At the same time, alarm signal scan be sent to monitoring devices;
4) UPS should have alarm record and inquiry function and record should be refreshed real-timely and be saved without power completely.

5.1.1. GEL CELL VRLA BATTERY BACKUP FOR 12 HOURS

VRLA tubular design deep cycle batteries shall be proposed, the total demand energy shall be calculated for battery sizing and backup time. The battery bank voltage shall be 48 Vdc. The batteries must provide high-quality and achieving superior performance, the manufacturing date must be new and not more than 6 months, suitable for every type of applications especially for solar renewable energy, designed Service Life 10 years with low internal resistance, designed to be deeply discharged. The Battery should provide benefits of being maintenance free, case flame retardant & non-hazardous. The battery bank shall also include battery temp. Sensor (BTS) and the following:

All necessary DC cables between the batteries together and to the battery fuse box to have a complete operational circuit with all bus bars, conduits, clamps, stainless steel bolts, washers and cable end terminations and all needed materials to complete the job. All DC cables must be sized in accordance with the installation requirements applicable on site, the allowable voltage drop must be less than 1%.

Battery Banks rack from the same manufacturer of the batteries with dividers and all needed accessories to finish the job. The rack must be enough to carry all the weight of the required batteries for the system.

Contractor must submit all the required certificates for all Battery Banks.

The battery bank for UPS system shall have following minimum features

- Best for cyclic applications
- High temperature tolerance
- Excellent for deep discharge
- Positive plate protective design
- Thicker plate for reduced Grid corrosion and increased cycle life
- High resistance to water loos and shorting
- Maintenance free operation
- Spill proof construction

All works and materials must be according to the drawings, specifications and supervisor engineer instruction’s and approval.

5.2. GENERATOR (DG SET)

Generator (DG Set) and UPS shall be sized with 30% spare capacity. Each DG Set shall be rated for environmental operating conditions of temperature -10 ~ 50oC and 90% relative humidity, and shall preferably comprise of suitable water cooling system. Generator shall consist of painted welded steel bed plate frame work to accommodate engine alternator complete with electronic governor to give regulation to BS:514 class A1, balanced flywheel, heavy duty starting batteries, battery charger, set of spare oil/fuel filters installed with engine panel having oil pressure and water temperature gauge, alternator electronic voltage regulator, radio interference suppressors, electronic tachometer, frequency meter, voltmeter with selector switch, ammeter with selector switch, hour runs meter, KWH meter, KW (total and per phase), kVA total and per phase, Power factor (Avg, total and per phase), kVAR (total), kVAR hour % of rated load, emergency

stop push button, radiator with water level switch, suitable for 400 /230 volts, 50 cycles/second, at 1500 rpm, for 3 phase 4 wire system including cost of all necessary material / accessories such as day fuel tank suitable for 48 hours of rated capacity. DG Set shall also be interfaced to Rawalpindi Ring Road (RRR) Telemetry software at control room for remote monitoring of the DG set

The work under this section consists of supplying, installation, testing & commissioning of all material & accessories with one (03) year of warranty from the date of installation after successful testing & commissioning for the complete Diesel Generators of Prime rating, duly to be established by the manufacturers de-rating curves, losses and efficiencies of the engine, alternator and DG Set including but not limited to power cables, Automatic Mains Transfer Switch/Automatic Main Failure Switch Panel, LV Switchgear, fuel tanks (including day and underground storage tanks), control panels, canopy, all accessories as specified here-in, and given in the Schedule of Prices.

The Diesel Generator (Prime rating) set shall be a standard design in accordance with the latest applicable International Standards of a reputed manufacturer, who shall have similar units in operations for similar applications and field conditions.

The DG set shall be of prime rated duty and suitable for indoor/ outdoor (as applicable) installation. It shall be capable for unbalanced loads up to 30% of actual load and for continuous part load operation. The set shall be capable of starting and operating at the rated output as per the climatic conditions (typical range given in the following table) and at an altitude of the site of installation (given level of the site of installation in meters above mean sea level). The power rating shown in the relevant section of Schedule of prices (bill of quantities) is the power rating required to be delivered to load by the diesel generator set after applying all de-rating factors relevant to the site.

The DG set ratings must be substantiated with manufacturer's standard published data. The Diesel Generator set after reducing the power absorbed by the auxiliaries, shall deliver rated power output under the site conditions. All auxiliaries, accessories and connections between systems along with all necessary cables, fittings, hardware, etc., for complete installation of Diesel engine, Generator, control panel, including fuel & oil storage, exhaust system, etc., shall be furnished by the manufacturer.

The engine shall be directly coupled to the generator, and shall have a rated speed of 1500 rpm. The set shall be capable of sustaining without damage, 25% over speed under any abnormal operating condition.

The engine-generator set shall be mounted on suitable rigid steel base frame with vibration isolators. Heavy duty lifting eyes and/or jacking screws shall be provided on the skid. The foundation bolts and all other material/hardware for complete installation of the set, as required, shall be furnished with the set. Any excessive torsional vibration shall be avoided for both engine and alternator. The set shall be suitable for full load starting. When the generator is operating at no-load, the application of full load current, taking into account the surge due to starting of equipment, should be possible with maximum transient voltage drop of 15% of the rated voltage. The time taken to restore the generator voltage to 97% of rated value should not exceed 1.5 seconds. The set shall be capable for starting and

accepting full load within 15 seconds after receipt of starting signal. The Manufacturer shall submit the equipment layout and other installation details along with the bid.

The details and technical data concerning Diesel Generator set shall be submitted with tender bid. Where required the documents from the manufacturer shall be furnished in support of the information furnished.

The alternator and engine shall be as follows:

Alternator Make/Brand:

Siemens, Newage/Stamford/Cummins, Lorrey-Sommer, Cater Pillar/ Olympian or approved equivalent.

Diesel Engine Make/Brand:

Volvo, Perkins, Cummins, Mitsubishi, John Deere, Cater Pillar or approved equivalent.

Operating Console:

DeepSea, Power Wizard, APM, Intli Compact, DataCom or equivalent

Warranty:

The DG Sets shall be supplied from the manufacturers/authorized agents or firms having strong local presence duly authorized by the manufacturer for sales, services and after sales back up support system and facilities along with suitable full time operation and maintenance experience with Pakistan.

The manufacturer/ authorized agent shall also have adequate maintenance facilities in the vicinity of Project with mechanically qualified and experienced personnel trained for operation and on-site maintenance of the equipment & materials offered by the Manufacturer in his bid.

To verify the capability of after sales service backup support locally in Pakistan, following shall be furnished by the contractor with duly verifiable documentary evidence from the supplier:

1) Complete company profile of the supplier, in house testing facilities, testing procedures, testing equipment/tools details.
2) Valid Nomination letter/dealership certificate from the DG set manufacturer for the supplier.
3) Successfully completed project reference list of the DG sets clearly indicating the project names, rating of the DG sets & quantity supplied alongwith the satisfactory performance certificates from the customers/authorities.
4) List of projects for which the supplier already providing O&M services alongwith customer satisfactory operational certificates for O&M.

The projects for which certificates shall be provided must be comparable in terms of quantities of the DG sets maintained.

The DG sets supplier /authorized agent/assembler shall be responsible for providing one (03) year of standard warranty and during the warranty period the supplier /authorized agent/assembler of the DG sets shall be fully responsible for replacements of any/all defective components/parts against manufacturing defects with the genuine products/components through the manufacturer/authorized agents under the supervision of the contractor.

The involvement of the manufacturer/authorized agent for maintenance/replacement of components is considered important because the warranty of the manufacturer becomes void

if genuine product/manufacturer recommended methodology/components installation is not followed.

Undertaking in this regard shall be submitted by the contractor as well as manufacturer/authorized agent/assembler to the Consultant.

5.2.1. APPLICABLE STANDARDS/CODES

The Diesel Engine and Generator set shall conform to the following standards as applicable.

ISO3046	-	(Reciprocating internal combustion engines)
BS 4999	-	General Requirements for Rotating Electrical Machines.
DIN EN 12285-2;2005	-	Horizontal Steel Tanks for the Storage above Ground of Petroleum Products in Liquid Form.

For other equipment and materials related to the Diesel Generator set, the Manufacturer shall follow relevant international standards:

5.2.2. DIESEL ENGINE

a) General

The Diesel Engine shall be four strokes, compression ignition, suitable for Emergency supply duty. Starting shall be through motor operated electric starter. The engine shall be equipped with an alternator type automatic charging system to charge the batteries during running of engine. The engine shall be provided with required auxiliaries, guarantees of fuel consumption, acceptance tests, torsional vibration characteristics.

b) Air Intake

Air intake shall be through turbo charger and equipped with dry type filter. Suitable attenuators shall be installed to reduce noise at the air inlet. The filter assembly shall be constructed of non-corrosive materials.

c) Engine Cooling

Engine shall have a forced air draft, water cooled radiator supplied with a core guard. Cooling system shall have an engine driven centrifugal pump for cooling water circulation. Cooling shall be thermostatically controlled. An engine shut down timer shall be provided to keep the engine running on no-load after any operation of set, so that the engine is sufficiently cooled to start again instantly, if required, without rise in temperature above safe limits. The radiator shall be designed to cool the engine at specified output in ambient temperature upto maximum value. Radiator flexible ducting, flange and all necessary ductwork, flexible connections, fittings and supports shall be supplied to extend from the radiator to the exhausts louvers so that hot air from the radiator escapes freely to the outside of the building.

d) Engine Lubrication

A gear type positive pressure lubrication pump shall be provided with efficient filtration arrangement for the lubrication system. A 230Volt AC mains-operated heater with thermostat shall be provided in the crankcase. The heater shall be designed for automatic switching to ensure that temperature of oil is maintained for proper operation of the engine.

e) Speed Governor

The speed governor shall be electronic or digital complying with the requirements BS ISO 3046 or latest applicable international standard. Governor shall regulate engine speed so as to maintain the generator frequency within ± 2% of the rated frequency. Stable engine speed shall be attained within 15 seconds after the engine has been started. Stable engine speed shall be restored within 10 seconds of any sudden change in load, from no load to full load. During this change of load or surge, the speed shall not vary by more than ± 5% of the rated speed. Means shall be provided on the engine to shut down the engine automatically in the event that the engine speed exceeds the "shutdown" speed.

f) Fuel System

Engine shall operate on Commercial High-Speed Diesel oil. A fuel oil strainer/filter shall be provided in the fuel line along with a water separator. Fuel system for Diesel engine shall not require any priming. The fuel system shall comprise;

- Fuel storage tank(s)
- Day Tanks
- Fuel transfer pumps
- Piping

The fuel day tank shall have capacity to store fuel oil for twenty four (24) hours continuous operation of the set at the rated output. The tank shall have level switch for monitoring low fuel level in the tank. The low-level switch shall provide an annunciation and prevent starting of set and to stop the set when the fuel in day tank is at this level. The tank shall be provided with overflow, vent, supply and discharge valves, inspection cover, drain valve and glass sight gauge.

The fuel day tank shall be designed, fabricated and finished in accordance with the requirements of DIN EN 12285-2;2005 - Horizontal Steel Tanks for the Above Ground Storage of Petroleum Products in Liquid Form. The fuel day tank shall be incorporated in the steel base frame of the DG set. The structural steelwork shall be protected from corrosion.

The fuel piping to be furnished shall include fuel supply pipe from tank to the set, over flow pipe from the set to the tank, level indicator, fuel cap with breather, drain pipe from the tank.

Drain Line: The day tank drain tank shall be accessible and equipped with a shut off valve. Self-supporting day tank shall be arranged to allow drainage into a 305mm high bucket. The local fuel fill port on the day tank shall be provided with a screw on cap.

g) Radiator Exhaust Duct

The radiator exhaust duct shall provide for exhaust of hot air through DG set radiator. The radiator exhaust shall be designed and routed in such a way so as to give minimum resistance to airflow.

h) Exhaust System

Exhaust system shall be equipped with a **HEAVY DUTY RESIDENTIAL** type silencer complete with muffler, exhaust manifold, flexible connector, exhaust elbow, exhaust pipe, rain cap, and associated fittings. This exhaust line shall be adequately covered with insulation material over its entire length i.e. from the engine to the termination point at rain cap. All supports for exhaust system shall be furnished. Hangs and supports shall be provided for the silencer such that essentially no load is transmitted to the engine.

i) Battery

Heavy-duty maintenance free lead acid batteries shall be provided with the set and mounted on the skid. The fully charged batteries shall be furnished with the set and connected with the help of heavy duty interconnecting cables.
The batteries shall be of adequate ampere-hour rating/capacity to satisfy the following requirements:

a. Crank the engine at firing speed for at least 15 seconds.
b. If the engine does not start on the first attempt, crank the engine two more times for the above duration at an interval of 30 seconds between each cranking operation.

5.2.3. ALTERNATOR

a) General

The alternator shall be synchronous. The alternator shall be capable of carrying, continuously 10% over load of rated output with the field set for normal rated load excitation for 1 hour in every 12 hours' operation.
The alternator shall be rated as follows:

Capacity	:	As stated in BoQ
Voltage	:	400/230 V
Phases	:	3Phase, 4 wire, grounded neutral
Frequency	:	50 Hz
Power Factor	:	0.8 lagging

b) Excitation

Excitation shall be from brushless rotating diodes mounted on the main shaft for 3-phase full wave rectification.

c) Windings

Alternator windings shall have Class H insulation and shall be impregnated for tropical use. The temperature rise of winding under normal operating conditions and at rated load shall not exceed the limits specified for Class-B insulation. Anti-condensate heaters shall be provided for windings. The heaters shall be thermostatically controlled for switching ON after the set has stopped. The thermostat range shall be adjustable and set to prevent

overheating of windings. For protection of windings from damage due to overheating, thermistors shall be embedded to stop the set in case the temperature of winding rises above the safe value.

d) Deviation Factor

The deviation factor of the open-circuit line to line terminal voltage shall not exceed 0.10.

e) Voltage Regulation

Voltage regulator shall be solid state with provision for manual setting. Regulator shall be so designed to protect the exciter when the set is running at reduced speed during starting or idling of the prime mover. Voltage regulation shall be + 2.5% from no-load to full load. Transient voltage drop shall be less than 15% at full load and 0.8 power factor. Time required to restore to steady state conditions after transient voltage fluctuation shall not exceed 10sec.

f) Short Circuit Capability

Generator shall be capable of withstanding without injury, a 30 seconds three phase short circuit at its terminals when operating at rated output and power factor with fixed excitation.

g) Temperature Rise

Alternator temperature rises at continuous rating in an ambient of 52˚C shall not exceed 70˚C by resistance measurement on the field. The exciter temperature rise shall not exceed 52˚C by resistance measurement on field or armature when the main generator is on continuous rating.

h) Vibration and Balance

The vibration level of the alternator when coupled to the engine shall not exceed the ISO Specifications or equivalent.

i) Bearings

The bearings shall preferably be grease lubricated and anti-friction type and shall be selected to provide for long trouble free service.

5.2.4. INDICATION/METERING PANELS

a) General

The indication/metering panel shall be designed for front access, completely assembled, wired and tested. The control panels shall conform to the constructional requirements as per international standards and norms.

The panel shall incorporate protection and control equipment, measuring instruments, control and instrument transformers, voltage regulator, governor controls, battery charger, indicating lamps, etc. Engraved nameplates of stainless steel shall be provided on all panels for clearly identifying panels and devices mounted inside of panels. Standard nameplate with black lettering shall be provided.

Cables and capillary tubing shall be tagged with a neoprene disc or approved equivalent, stamped with the cable number or tube function for easy identification.

b) Moulded Case Circuit Breakers

The Four pole moulded circuit breaker shall be provided with the set. The circuit breaker shall have the Thermal over current and short circuit releases as below:

Ith = 60 to 100% of Current rating

Isc = 50 kA (min)

The circuit breaker shall be mounted in a vibration isolated sheet steel box with adequate access for incoming and outgoing cables.

c) Magnetic Contactors

The contactors shall be four pole, 400 V AC duty cycle-3. The main contacts shall be silver tipped, but type with double break per pole. Each contactor shall be provided with 230V AC single phase operating coil,and minimum two normally open and two normally closed auxiliary contacts wired upto terminals. But if more number of working auxiliary contacts are required then, these shall be provided according to the system requirements.

d) Battery Charger

Multi stage intelligent (Digital Microprocessor based with a communication port RS 485) high efficiency battery charger with automatic charging stage selection, capable of charging of a wide range of batteries, when engine is not running. The charger shall be fully capable to recharge a completely discharge battery within four hours at boost/maximum charge. The charger shall be of constant voltage and constant current with maximum current been drawn during charge recovery phase. The charger should automatically return to float/trickle mode when charging is complete.

The charger should have following safety features:

- Input under voltage protection
- Input over voltage protection
- Battery charge over voltage protection
- Battery output over current protection
- Short Circuit protection
- Battery temperature compensation with over temperature protection
- Reverse Polarity protection
- Automatic power derating at high ambient temperatures

Applicable Standards for Battery Charger:

- BS EN 61000 (Electromagnetic compatibility)
- BS EN 60950 (Electrical safety)
- BS EN 60068 (Temperature, Vibration, Humidity and Shock)
- BS EN 60529 (degree of Protection)

Instruments and Controls

- Ammeter (measuring as required)
- Ammeter Phase selector switch
- Voltmeter (0-500 VAC)
- Voltmeter phase selector switch
- Frequency meter
- Start / stop key switch
- Battery condition voltmeter
- DC Voltmeter for batteries
- Tachometer for Engine speed in Revolutions
- Per Minute (RPM)
- Lube oil pressure in PSI

- Lube oil temperature in Degrees Celsius
- Engine water temperature in Degrees Celsius
- Engine operation/ running time in hours

5.2.5. SAFETY DEVICES

Following safety devices shall be provided. The audible alarm shall operate on any fault condition and shall be resetable manually and automatically through a timer after 15 minutes whichever is earlier:

A = Alarm **SD** = Shutdown **TD** = Adjustable Time Delay

i)	Engine Over speed	**A**	**SD**	
ii)	Low lube oil pressure	**A**	**SD**	
iii)	High water temperature	**A**	**SD**	
iv)	Over voltage	**A**	**SD**	**TD** (0-30 Sec.)
v)	Under voltage	**A**		
vi)	Short circuit and Tripping of circuit breaker.	**A**	**SD**	**TD** (0-1 min.)
vii)	Low level in fuel storage tank	**A**	**SD**	**TD** (0-5 min.)
viii)	Winding temperature high	**A**	**SD**	**TD** (0-2 min.)
ix)	Over crank (After THREE Successive crankings)	**A**	**SD**	
x)	Low crankcase oil level	**A**		
xi)	High crankcase oil level	**A**		
xii)	Charging alternator failure	**A**		
xiii)	Charger failure	**A**		

For all shut down conditions, the set shall lockout and it shall not be possible to re-start it unless manually reset after the cause of fault has been removed.

a) Generator Electrical Protections

Following electrical protections shall be provided in the generator:

1. High AC voltage shutdown	12. Reverse Power shutdown
2. Low AC voltage shutdown	13. Reverse VAR shutdown
3. Over frequency shutdown:	14. Under voltage shutdown:
4. Under frequency shutdown/warning	15. Over voltage shutdown:
5. Over Current warning/Shutdown:	16. Low and high battery voltage warning
6. Loss of sensing voltage shutdown	17. Weak battery warning
7. Field overload shutdown	18. Fail to start (over crank) shutdown
8. Over load (kW) warning	19. Reverse power protection
9. Short circuit protection:	20. Smart starting system
10. Digital Voltage Regulator	21. Battery monitoring system

11. PMG Excitation	

b) Auto-Mains Failure/Transfer (AMF/ATS) Panel

The AMF/ATS shall be floor mounted front access, completely assembled, wired and tested. The control panel shall conform to the constructional requirements as stated in these specifications for LV switch boards.

The AMF/ATS shall incorporate automatic changeover system, which will be designed for the following functions:

(i). To start the set immediately when the main supply fails

(ii). To start the set within the 0 to 1 minutes (adjustable) whenever the main supply voltage drops to 360 volts or rise to 440 volts. The setting voltages shall be adjusted within -5 % and + 5% respectively for the lower & upper ranges.

(iii). To transfer the load from Generator to main supply whenever the main system voltage returns between 90% to 110% of its rated value and persists for at least 3 minutes.

(iv). To make two successive attempts, in case the set fails to start in the first and second attempt.

(v). The system shall provide for immediate transfer of load to the generator, after the rated speed and voltage have been achieved. The Generator should start immediately when the main supply fails

(vi). The system shall be self-resetting after each cycle of operation. To start the set immediately when the main supply fails

(vii). Two normally open potentially free contacts shall be provided which shall close when the set is started with the operation mode selector switch in auto or manual position. The contacts shall be wired up to the terminals block in control panel.

(viii). A four position selector switch shall be provided for selecting the operation mode i.e. Automatic-Manual-Test-stop/ Maintenance mode to facilitate the following operation:

- **Automatic:**
  As described in (i) to (iv) above.
- **Manual:**
  Manual starting of the set and load transfer from normal to standby and vice versa.
- **Test:**
  Testing the changeover operation when so desired and also for starting and running the set without interrupting the normal operation. In case of failure of main supply, the set shall automatically revert to automatic mode of operation.
- **Stop/Maintenance:**
  Provision shall be made to isolate the system for trouble shooting and maintenance without interruption of mains power supply. The set shall not be capable of starting in this condition.

5.2.6. TERMINAL BLOCKS AND TERMINALS

Terminal blocks for control wiring shall be General Electric Type Eb stud terminal blocks or approved equivalent. Terminal studs and wires shall be numbered or otherwise marked in accordance with the applicable schematic and wiring diagrams.

Terminal blocks shall be arranged with sufficient room for each connection of incoming cables. Parallel rows of terminal blocks shall be spaced at least 150mm (6") apart.

Blocks shall be mounted in vertical columns along the sides of cubicles or on vertical panels specially provided for terminal blocks. 20% spare blocks distributed over the columns of terminal blocks shall be provided.

Terminals shall be suitable for screw terminals and shall be sized according to the wire being terminated.

Provisions shall be made to terminate and ground the overall copper shields of all incoming cables by a suitable method approved by the Engineer.

5.2.7. COMPONENT WIRING

All internal wiring shall be in accordance with IEC or VDE Standards with annealed copper conductor, thermo-plastic insulated with an overall flame- retardant braid. Wire sizes for control wiring in no case shall be smaller than 2.5 mm^2. The wire ends shall be permanently fitted with compression type connectors before attaching to terminal studs.

Wiring between terminals of various devices shall be point to point. All internal wiring shall be neatly trunked in wiring troughs bound and anchored.

All groups of bundled conductors to hinged doors and panels shall use extra-flexible wire arranged so that a twisting rather than a bending motion is imparted to the moving conductor bundle. Each bundle shall be anchored to the fixed member at the opposite end of the hinge axis to the anchoring point on the moving member so that the moving bundle length is the maximum available without loops.

All wires shall be identified at both ends according to the schematic diagram.

5.2.8. FUEL TANK, CANOPY AND FOUNDATION PAD

a) Fuel Tank

Supply & Installation of backup fuel storage tank, complete with filling cap, vent & suction pipe, minimum 5mm thick, MS sheet and inspection man hole complete in all respect.

b) Weather Proof and Sound Attenuated Canopy

Sound and weather proof canopy suitable for the Diesel Generating sets. The canopy shall attenuate the sound level to below 85dB at a distance of 1 meter or less than 75dB at a distance of 3 meters from it. Textured insulation materials, comprising of fire retardant resin, organic glass/rock fiber to ensure uniform long lasting absorption of sound. The canopy shall be constructed with weather proof corrosion resistant material and shall be modular in design. All sheet components pre-treated with cold fast prior to powder coating. All gas kits/joints be of Edpm (**ethylene propylene diene monomer** (M-class) rubber). The canopy shall be suitable for tropical climates.

- The enclosure shall allow easy access to the engine, alternator, and radiator filler cap, lube oil filling, filter replacement and control cubicle for easy maintenance purposes.
- Hinged and lockable doors all around canopy for easy access to D.G. set for routine maintenance and major over hauling.

- At least 1-foot clearance between the DG Set and Canopy shall be maintained from sites/directions.
- The enclosure shall be designed to be water and weather- proof.
- The intake area for air must be 1.8 times the size of radiator.
- The enclosure base frame should be designed with supports for easy transferred using forklift and crane.
- Canopy shall be capable of anti-corrosion to withstand high humidity.
- Proper grouting of both generator and canopy.
- The thickness of sheet for canopy body must be 4mm (minimum) whereas thickness of and door sheet 2mm (minimum).
- Glass wool will be of pure fiber.
- The canvas is to be place between radiator and the canopy that can be easily removed during troubleshooting.
- GENSET control panel should be visible from outside the canopy by means of plan glass.
- 4 Nos. Canopy lifting eyes arrangement from top of canopy.
- Sufficient air intake through Acoustic Louvers from both side & control panel side.
- Duly painted with good quality water proof and weather proof paint. Painted with 2 coats of zinc oxide primer and finishing with 2 coats of Syntactic Enamel (Burger/ICI) paint.

c) Foundation Pad for DG Set

- Fabrication of RCC Foundation suitable for GENset operating weight complete in all respects, foundation to be made according to generator size and should have all required sleeves for piping, conduit etc. as per specifications.
- The pad should be at least 12 inches (300mm) height from and extend at least 6 inches (150 mm) beyond the skid on all sides.
- The weigh (W) of the foundation should be at least 2 times (and up to 5-10 times) the weight of the set itself to resist dynamic loading. (The weight of fuel in a sub-base fuel tank should not be considered to be contributing to the weight required of a vibration isolating foundation even through the isolators are between the tank and the generator set).
- The foundation should extend at least 6 inches (150mm) beyond the skid on all sides. This determines the length (I) and width (w) of the foundation.
- The foundation should be reinforced concrete with a 28-days compressive strength of at least 3000 psi

5.3. AC UPS

AC UPS shall comprise of chargers, battery bank and invertors having input/output voltage suitable to the application. The switch over from mains to the UPS supply and vice versa shall be accomplished in less than 5 msec and shall be suitable for supplying a nonlinear load. The UPS shall be an online type preferably incorporating a six-pulse rectifier and pulse width modulation inverter technology with microprocessor control. It shall incorporate a static bypass switch which shall operate in the event of UPS failure, overload or manual initiation. The UPS shall incorporate a DC under voltage trip circuit to electronically trip the UPS output in order to protect the batteries. The output of the inverter shall be a sine wave having less than 2% THD for linear loads and less than 4% for 50% nonlinear load. It shall be suitable for load power factors 0.7 lag to 0.9 lead. The

unit shall have a dynamic response to a 100% step load causing an output voltage transient of less than ± 4% with a recovery time of less than 4 ms. For three phase output units the output voltage shall not vary by more than ± 1% for an unbalance of 10%. The efficiency at full load and 0.8 power factor shall be greater than 80%. The unit shall incorporate a monitoring and diagnostics system to provide an audible alarm to provide warnings and fault indication. It shall be possible for Operations and maintenance personnel to determine the cause of UPS failure by viewing a fault annunciation display or by interrogation of a 'user friendly' integral key pad and display unit. UPS shall also be interfaced to Rawalpindi Ring Road (RRR) Telemetry software at control room for remote monitoring of the equipment.

Backup time of UPS at Primary Data Center and DR DATA CENTER shall be 24 Hours. The UPS shall have an overload capacity of 200% for 30 seconds and 140% for continuous Load and shall be protected in the event of a short circuit of the output.

5.4. SOLAR / PHOTOVOLTAIC SYSTEM

The Contractor shall provide an integrated 3-Tier Hybrid Solar / Photovoltaic system which shall operate in conjunction with Solar Panel, utility electrical power provided by the Distribution Company and Batteries at each of the Pole Sites. The installed system must meet applicable national standards and codes. PV modules shall comply to the requirements of IEC 61215 standards. All the solar panels shall be made of mono-crystalline silicon solar cell having minimum of Peak Power (Wp) 600W, 60 cells and 16% efficiency under STC conditions. All the associated electrical accessories shall be included in the supply such as connectors, cables, connector boxes of IP65/67 ratings and galvanized steel/aluminum structure/rails/mounting. PV life shall be minimum of 25 years associated with warranty of linear performance of efficiency for the same years. Solar Panel shall withstand environmental conditions of minimum of 5000 Pa snow load, 2000 Pa wind load, 30 mm hail storm with 90km/, temperature -20°C to 55°C and relative humidity ≤95%. Solar Panel and system shall be well protected with properly sized individual short circuit fuses and system breaker(s). Adequate lightning protection and earthing system shall also be installed.

The batteries shall be of maintenance free Gel sealed type for life as per IEC-60896-2/BS6290 certification. Batteries shall be contained within translucent impact resistant flame-retardant polypropylene cases. They shall be designed for low maintenance and shall have a life in service of at least 5 years. Terminals shall be shrouded to prevent accidental contact. The battery enclosure shall be corrosion resistant and ventilated to prevent the buildup of gases. Battery sizing calculations shall be based on Standard IEEE 485. The battery shall have minimum of 80% depth of discharge. The battery recharge time to 90% of full charge shall be approximately two times the discharge time at full load. Battery charge time shall be optimized with higher charge currents and multi-stage charge methods.

Pole Stations shall have solar backup power for 24 hours. Power equipment and cameras shall be mounted on poles with minimum heights of 30 feet, though the cameras may be placed at 28 feet level, if needed. Poles shall also be provided with anti-climbing sensors.

A Solar Power Supply System with provision of net-metering will be installed at the rooftop of the toll stations, service stations, control center building, DR building. Solar system shall also be installed on camera poles. Size of the solar system shall be proposed based on the suitably available space at the rooftop. based on the Solar PV System shall act as a primary source of energy for the operation of electrical, mechanical and communication system equipment, grid supply shall act as a secondary source of energy for the building. In case of availability of excess energy from solar system, the net-metered connection shall be able to inject the energy into the grid.

The solar PV system shall have a lifespan of 25+ years with 80%+ output guaranteed. PV Modules shall be polycrystalline type with an efficiency of 16% or higher. System shall be sized in accordance with the availability of space on the rooftop.

The following design factors need to be detailed in the Bid:

5.4.1. PV MODULES

- Bill of Materials, BoM: (glass, encapsulated, back sheet, ribbon, adhesives, cable, junction box, connector).
- Maximum rated power
- Rated power tolerance
- Minimum efficiency at 200 W/m² (25°, AM 1.5)
- Power conversion efficiency at STC
- Installation Angle
- Fill factor
- Series fuse rating
- Connector type
- Cable length
- Materials and workmanship warranty of a minimum of 10 years
- Power warranty/performance guarantee of a minimum of 25 years: the power output should not fall below 90% within 10 years, and below 80% within 25 years; linear warranty mandatory
- Cross-sectional view of the module materials
- Type of cells comprising the module, and number of cells in series
- Use of integrated bypass diodes
- Voltage at the maximum power point
- Current at the maximum current point
- Open-circuit voltage
- Short-circuit current
- Maximum system voltage
- Temperature coefficient of short-circuit current
- Temperature coefficient of open-circuit voltage
- Temperature coefficient of maximum power
- Operating temperature range and nominal module operation temperature

- Tolerance to wind (maximum load) impact
- Relative PCE reduction and I-V curves for different light intensities
- Compatibility to different inverter designs
- Dimensions and weight
- Type of frame with weatherproof specifications

The following shall be applicable:

- IEC 61646
- IEC 61730
- IEC 60364-4-1
- IEC 61701
- IEC 60904-1
- IEC 60904-3
- Other applicable standards

5.4.2. VISUAL INSPECTION OF MODULES

a) For the purpose of onsite acceptance of modules, following visual defects shall be looked out for:
b) Broken, cracked, or torn external surfaces
c) Bent or misaligned external surfaces, including superstrates, substrates, frames and junction boxes to the extent that the operation of the PV module would be impaired
d) Bubbles or delamination forming a continuous path between electric circuit and the edge of the module
e) If the mechanical integrity depends on lamination or other means of adhesion, the sum of the area of all bubbles shall not exceed 1 % of the total module area
f) Evidence of any molten or burned encapsulant, back sheet, front sheet, diode or active PV component.
g) Loss of mechanical integrity to the extent that the installation and operation of the module would be impaired.
h) Cracked/broken cells which can remove more than 10 % of the cell's photovoltaic active area from the electrical circuit of the PV module.
i) Voids in, or visible corrosion of any of the layers of the active (live) circuitry of the module extending over more than 10 % of any cell.
j) Broken interconnections, joints or terminals.
k) Any short-circuited live parts or exposed live electrical parts.
l) Module markings (label) are no longer attached or the information is unreadable.

5.4.3. INVERTER

The Bidder shall arrange a full-service package for the selected inverters for a warranty period of at least 5 years. The Bidder shall explain its strategy of distributed or centralized inverters, as the case may be, keeping in view of the following considerations:

- Balance of System (BOS) costs of inverter and labor
- Dust and heat protection

- Increased fault tolerance
- Optimizing the inverter's DC capacity with respect to the PV array
- Physical placement
- Timely and effective monitoring at a granular/zoomed-in level
- Available uptime
- Ease of replacement
- Cost of maintenance
- Consideration of master-slave designs
- Description of MPP tracking
- Protection against overload, short-circuit, grid-failure, internal failure, over-temperature (de-rating), surge protection etc.

The selected inverter should not only deliver DC to AC conversion for use by the AC load, but also offer the following functionality which shall be confirmed at the bidding stage of the Project:

- Maximum Power Point Tracking (MPPT)
- Matching grid voltage and frequency at point-of-coupling
- Anti-islanding protection
- Conform to the Grid Code and DISCO's Requirements
- Frequency regulation
- Voltage and frequency fault ride-through
- Limitation of voltage fluctuation due to switching operations and long-term flicker
- Limitation of short-circuit current
- Input voltage range (The voltage window for MPP tracking shall accommodate the expected degradation of the modules.)
- Maximum operating input current
- PV array configuration options: positive ground, negative ground
- DC input combiner options
- Integrated transformer/transformer less / Outside Dry Type Transformer
- Peak efficiency
- Weighted efficiency
- Efficiency variation for various AC loads
- MPP tracking efficiency
- Nominal power
- Nominal output voltage
- Output voltage range
- Maximum output current
- Standby power consumption
- Nominal output frequency, 3-phase
- Harmonic distortion
- Power factor at full load

- Dynamic power factor control
- Power curtailment range and unit steps
- Fault tolerance and automatic system recovery
- Operating temperature range
- Conversion efficiency dependence on temperature
- Cooling method
- Detection of insulation faults
- Noise levels at a distance of five meters
- Humidity tolerance
- Dimensions and weight
- Anti-discharge, reverse polarity, and lightning protection
- Protection rating: NEMA 3R, IP54/IP55/IP60

The following standards and industry practices shall be followed, as technically relevant:

- IEEE 1547
- ANSI/IEEE C37.90-2
- ANSI/IEEE C37.98
- ANSI/IEEE C37.2
- IEC 255-21-1
- IEC 255-22-2
- IEC 255-5
- IEEE 519
- EN 50160
- EN 51078
- EN 61400-21
- IEC 61000
- IEC 60439-1
- IEC 62109-1
- IEC 62109-2
- IEC 60529
- IEC 60721-3-3
- TUV, VDE, or equivalent certification of passing the relevant standards
- Other applicable standards.

The Bidder shall be required to provide a manufacturer's confirmation at the detailed design stage for the suitability of the inverter for the specific weather conditions applicable in Pakistan.

5.4.3.1. INSPECTION OF INVERTERS

Check of protection against overload, short-circuit, grid-failure, internal failure, over-temperature (de-rating), surge protection, detection of insulation faults of AC Cables.

5.4.4. WIRING, GROUNDING AND MOUNTING REQUIREMENTS

UL 1703 approved module mounting and grounding guidelines provided by the manufacturer shall be applied for the installation of PV Modules at the rooftop. The mounting structure shall be able to withstand the wind speeds of up to 160 kmph without impacting the structural integrity of the rooftop.

Array Sizing along with DC and AC Wiring shall be made in accordance with IEC 62548 standard. For this purpose, the Contractor shall be required to provide detailed calculations prior to installation of equipment on site. Connector type MC4 shall be used wherever required.

6. IP BASED VIDEO SURVEILLANCE SYSTEM

6.1. NETWORK BASED CAMERAS

Video Surveillance System shall be used to provide 100% constant coverage of the entire Ring Road including TCC, Toll Plazas, Weigh Stations, Service Area entrances/exits etc. Fixed, PTZ and ANPR type cameras shall be used.

Various types of cameras shall be used in video surveillance system for security and surveillance applications such as Fixed, PTZ, ANPR cameras and speed Detection Cameras etc. The CCTV Cameras to be deployed shall be suited to the environment of the Ring Road including use during incidents and shall be rated to at least IP67. Cameras shall have the facility for the screen to be cleaned by remote control from the TCC.

ANPR cameras shall be used to record the vehicle registration numbers of passing traffic at all entry and exit of Ring Road and other key locations where required. By matching the encrypted vehicle registration number between camera locations, a journey time can be derived between those two ANPR locations.

Network Video Recorders (NVRs) shall be installed at TCC and Toll Plaza control center. Video monitoring data of a Toll Plaza, nearby Weigh Station and roadside cameras shall be transmitted and stored to the Toll Plaza control center NVR and the TCC which shall be stored with related time stamp and camera location. The NVR shall have sufficient capacity to store video images at full speed and full resolution.

The Video surveillance system shall be designed for continuous operation for a service life of 15 years regardless of location and in accordance with manufacturer's recommendations. Video surveillance system shall be able to fully integrate with the ITS application and management software at the TCC. The information from video surveillance system shall be collated by the TCC and will be used in the future to inform drivers using VMS.

6.1.1. STANDARDS

All equipment shall be of imported origin. Equipment design and manufacturing shall be only from Europe, USA and/or from the list of mentioned brands at the end of these specifications. Materials/Equipment shall be designed, manufactured, tested and installed according to the BS/IEC/ISO/ITU/EN/CE Recommendations. The latest edition and amendments shall apply in all cases. As a minimum, following shall be applied

a. EN 55022:2010 Information technology equipment– Radio disturbance characteristics– Limits and methods of measurement.
b. EN 60950-1:2006/A11:2009/A1:2010/A12:2011/A2:2013 Information technology equipment – Safety – Part 1: General requirements.
c. EN 55032:2015 Electromagnetic compatibility of multimedia equipment – Emission requirements.
d. IK 10, BS EN 62262:2002: Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
e. BS EN 61000-3-3:2013: Electromagnetic compatibility (EMC). Limits. Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems.

f. EN 55024:2010+A1:2015: Information technology equipment. Immunity characteristics. Limits and methods of measurement
g. EN 61000-3-2:2014: Electromagnetic compatibility (EMC). Limits. Limits for harmonic current emissions.
h. ONVIF (Open Network Video Interface Forum). Under process Network interfacing standards for cameras

6.2. OUTDOOR FIXED CAMERA

The outdoor fixed camera shall be used at Toll collection center, service area, DR DATA CENTER, Control Room, and Entry/Exits of Ring Road. The outdoor camera shall be 8 Mega Pixel with motorized zoom lens, 60 frames per second, ONVIF protocol, multi streaming mode, Profile S/G, HLC, BLC, DNR, anti-flickering, RTCP protocol for video streaming, latest video compression, multi-privacy zones, two-way audio input/output, video content analysis, facial recognition, cross counting for human and vehicles.

The Fixed cameras shall have 128 GB local SD card storage and feature of smart IR (Infra-red) or Night Vision. StarVis latest technology shall be provided for highly detailed images in extreme low-light situations during Night vision (0 lux). The camera shall see every detail in both bright and dark areas of the scene to provide excellent color performance even with a minimum of ambient light.

The camera shall have Intelligent Seeing Analysis i.e. edge level features of Motion Detection, Distinguish Objects, Region of interest (ROI), Tamper, Abandoned object, Object Disappearance, Parking Detection, Zone Entrance, Object Counting, Multi Loitering, Face Detection, etc.

The camera shall be equipped with deep learning algorithm having People Counting technology which shall track and process moving human body targets to realize the accurate statistics of ‘enter No.’, ‘leave No.’, and ‘In Area No.’ working in conjunction with management platform and shall also provide outputs in the form of yearly/monthly/weekly/daily reports. Fixed Camera shall have the 60MB/s bandwidth for best performance.

The camera shall have Video Metadata technology which can detect, track, capture vehicle, non-motor vehicle and people, and select the best images as well as extract attributes.

The camera shall have Perimeter Protection technology which shall recognize human(s) and vehicle(s) accurately, and shall have detection in restricted areas (such as pedestrian area and vehicle area). The false alarms of intelligent detection based on target type (such as tripwire, intrusion, fast moving, parking detection, loitering detection and gathering detection) shall be minimal.

The camera shall have digital signal processor and shall be capable of supporting two-way audio support enabling it to install Public Address (PA) functionality. The camera shall have features of Anti-fog, anti-flickering and Power over Ethernet (POE). Camera shall be suitable to operate under the environmental conditions of temperature -30°C to 60°C and relative humidity ≤95%. Camera shall have metal casing with protection class IP67, IK10 and have the lighting / surge and volts protection standard TVS 4000 V.

The camera shall be certified from international standard i.e. Chartered Engineers (CE) Europe, European Standard EN, Federal Communications Commission (FCC) etc.

6.3. OUTDOOR PTZ CAMERA

Outdoor PTZ camera shall be used for monitoring of entire Ring Road including TCC, toll plazas, approaches/exits etc. The outdoor PTZ camera shall be used after every 500 meter of the Ring Road. The outdoor camera shall be 3 Mega Pixel or higher with 30X optical zoom, 30 frames per second, viewing profiles, with Artificial Intelligence. The camera shall have Video/Audio Compression H.264+, H.265+ encoding, High compression, Wide dynamic, 3D noise reduction, HLC and BLC. The PTZ cameras shall have 128 GB local SD card storage and Smart IR (Infra-red) night vision. Star technology shall be provided for highly detailed images in extreme low-light situations during Night vision. The camera shall see every detail in both bright and dark areas of the scene to provide excellent color performance even with a minimum of ambient light.

The camera shall have digital signal processor and shall be capable of supporting two-way audio support enabling it to install Public Address (PA) functionality. The camera shall have features of Anti-fog and POE. Camera shall be suitable to operate under the environmental conditions of temperature -30°C to 60°C and relative humidity ≤95%.

The camera shall have edge level analytics features of Motion Detection, Region of interest (ROI), Tamper, Parking Detection, Zone Entrance, Object Counting, Multi Loitering, Face Detection and most important face recognition feature. The function allows triggering a local alarm, sending an e-mail, controlling the relay, or sending a push notification to the mobile application after recognizing the face marked in the built-in database as enforcement "wanted" face.

The camera shall be equipped with deep Learning Algorithm technology which shall track and process moving human body targets to realize the accurate statistics.

The camera shall have Video Metadata technology which can detect, track, capture vehicle, non-motor vehicle and people, and select the best images, and extract attributes. The camera shall have Perimeter Protection technology which can recognize human and vehicle accurately. Privacy Protection technology can mask the detected face and human body to protect the privacy of some special targets. The camera shall have Advanced Facial Recognition Analytic Function to achieve real time face capture and comparison. The camera shall be certified from international standard i.e. Chartered Engineers (CE) Europe, European Union standard EN / EU, Federal Communications Commission (FCC) etc.

6.4. ANPR CAMERA

The Automatic Number Plate Recognition (ANPR) Camera shall have 5 Mega pixels. The ANPR shall be used for Entry /Exit Toll station and/or other locations to record number plates information. ANPR camera shall have capability of operating day/night and capturing image of standard and nonstandard number plates of vehicles.

The ANPR Camera shall have internal memory buffer even 50 violations per second at peak. The ANPR Camera shall support IP67 for outdoor environments.

ANPR camera shall be integrated with Access Control and Toll Collection System. The ANPR Camera shall have embedded algorithm inside the camera optimized to capture number plates issued by the local authority. The ANPR Camera shall have advance Artificial Intelligence features including Vehicle data structuring, license plate recognition, vehicle size (large bus, heavy truck, medium truck, sedan, minivan, light truck, SUV, MPV, medium bus, pick-up and mini car) and vehicle color detection. The ANPR Camera shall support Video detection or loop detection for capturing of License plate. Camera shall be suitable to operate under the environmental conditions of temperature -20°C to 55°C and relative humidity ≤95%.

6.4.1. CENTRALIZED BACK OFFICE SOLUTION FOR MANAGEMENT OF MANY ANPR CAMERAS / ANPR SYSTEMS

ANPR Centralized Back Office solution for management of many ANPR Cameras / systems. Web-based secured access allows assignment of dedicated personnel with different roles to manage operations from a central location. Pol Camera Back Office solution allows collecting evidence from hundreds of different systems spread around the country. ANPR System workflow allows to assign multiple violations, print custom made tickets, track the payment and manage the payments by the online system. Additional features like a connection to the national database and court module make the violations processing efficient and secure.

6.4.2. SMART EVIDENCE

The ANPR Camera / System shall have the Smart Evidence Photo can use for immediate printout and Automatic Ticketing systems. The ANPR Data protection algorithms secure data from manipulation and warranty successful certification in any country. System software can use the same image for multiple violations. System performance allows generating up to 25 Smart Photo violations per second. By using internal memory buffer even 50 violations per second at peak.

ANPR Software produces a series of high-quality Smart Evidence photo/video including all relevant information describing the violation. The data bar includes in particular: date and time, frame counter, device serial number, software checksum and version, custom text, evidence number, vehicle speed, speed reduced by allowed error, average speed in measuring zone, tracking radar speed or/and scanning laser speed, vehicle type (A – passenger car, B -truck), vehicle size, lane number, vehicle number plates, vehicles direction (incoming, outgoing), vehicle ID number, vehicle speed and speed above the limit, vehicle location on the road (X,Y) in meters, facial characteristic, operator ID Code, GPS position, over 70 characters of location description, full size automatically cropped vehicle, cropped picture of the number plate, speed limits (in addition different limit on different lane and time period), set alarm speed, flash option sets (Always, Automatic, off), graphic road plan view, tolerance walk for alarm trigger, traffic light status and time and more if required like certificate number, user institution address etc.

6.5. SPEED DETECTION CAMERA

- Speed camera shall be used on both sides after every 20km of the Ring Road.

- Speed Detection Camera shall have the full control of up to 32 vehicles simultaneously with including individual speed tagging, distance and other essential meta-data of each captured car. Automatic monitor different speed limits for each lane as well as vehicles types.
- Speed Detection Camera shall have the evidence providing as full-HD video and hi-resolution still photo-graphs of license plates and facial characteristics through the camera automatically adapt to changing environments together with the flash system can operate at any conditions on a 24/7 basis, day and night and various weather conditions (snow, rain, fog).
- Camera quality and advanced tracking technology allow to monitor vehicles at typically measuring zone from 10 m to 80 m at a six-lane road. System support road slope and road radius above 80 m.

6.5.1. SYSTEM MAIN FEATURES

a) Even/odd violation:

The system captures vehicles with not allowed number plate type. Built-in schedule defines the whole calendar of number plate type allowed to use the public road.

b) Black list violation

The system continuously monitors each vehicle on the road. Automatically recognize number plate and compare with the internal database. Successful match result evidence creation.

c) Too close violation

The system continuously monitors the position of each vehicle on the road. Automatically recognize cars driving too close and create evidence of such driving behavior.

d) Recorded Materials

Camera shall have the high quality 5 to 12 Mega Pixel image, HD video with light status change video, complete metadata.

The system captures photo evidence when the vehicle is before violation line, track the car and record the violation with an additional high-quality photo when violator passes the crossing at the red light.

e) Restricted lane

The system captures vehicles traveling on a marked lane (ex. bus lane) and store HD photo and video material.

f) Lane Change Violation

The ANPR system shall captures vehicles changing lane at not allowed place. On a continuous line or zebra crossing.

g) Evidence Browser

The ANPR device shall come with Windows-based Evidence Browser for local evidence management and processing

The software shall have the following features:

- Browse encrypted evidence files
- Store and manage evidence in local DB
- Mark/ crop/zoom in the vehicle in violation
- The photo of the driver
- Vehicle number plate
- Adjust brightness
- Contrast, and histogram
- Generate Smart Photo for printing tickets
- Create video/evidence package for hearings
- Restore and archive evidence on DVD or any other storage media

6.6. IR ILLUMINATORS

Infrared illuminators emit light in the infrared spectrum, making their rays (and illuminating effect) invisible to the human eye. As a result of this, infrared or IR illuminators have a wide range of functions 100 to 150m; from providing light for night vision security cameras to serving as a covert flashlight for hunting.

6.7. NETWORK VIDEO RECORDER

The Network Video Server/Processor and Storage/Recorder shall be 150 CH optimized to view, store, manage and analyze real-time and recorded video in a networked environment. The system shall provide a highly scalable and reliable platform to support customized and network-based surveillance applications. The Network Video Recorder shall support 3 monitor x 4K Ultra HD resolution (12MP), H.264/H.264+, H.265/H.265+, any specified frame rate. The Network Video Recorder shall have the recording speed up to 3750 fps at 1920 x 10805 and shall have the ports for 5 x SATA 3.5” hard disk drives with Windows 10 operating system. VMS (Video Management System), ability to schedule operator shifts, event filters, temporary views and The Open Network Video Interface Forum (ONVIF) while simultaneously supporting 3rd party IP based cameras from a variety of different vendors.

The system shall display any combination of live and recorded camera feeds on multiple workstations simultaneously using an IP network. The system shall provide a Management Console /dashboard that shall show the status of Memory, Disk Usage, and traffic analysis. The system shall provide for integration with other software applications through an open and video analytics. The system shall support simultaneous video feeds including sub-streams minimum of five from each camera across multiple locations for centralized and decentralized storage, display, and distribution of video without limitation.

The system shall allow instant replay of video and shall permit pausing of live video, forward and backward review of recorded video, and return to live viewing. The system shall provide flexible archiving capability in terms of frame rate, duration, and location and shall utilize dynamic file allocation to ensure that the full duration of the selected video stream shall be recorded, regardless of lighting condition, motion, or scene detail.

Loading of all Servers shall not be more than 60 - 70%. The Network Video Server/processor and Storage/Recorder shall be certified from an international standard i.e. Chartered Engineers (CE) Europe, Federal Communications Commission USA (FCC), Under Laboratory USA, etc. All the Servers or associated components shall be suitable to

operate under the environmental conditions of temperature -20°C to 55°C and relative humidity ≤95%.

6.8. CLIENT WORKSTATION/ VIDEO MONITORING STATION

Video Monitoring Station (VMS) shall be provided at Toll Plaza control center and TCC. The Surveillance System has a wide range of settings for video streams sharing and allows the users to create complex monitoring systems with spread recording and surveillance centers containing many personalized operator stations.) has no license restrictions on the number of connected devices, number of login users and drives capacities, and that gives a possibility to create systems with a several hundred cameras. Customizable user interface and multi-screen mode allows the system operator to work effectively and check the recording and copy the recording on demand of enforcement.

6.9. STANDARD 12M POLE FOR CAMERA

- The standard pole should be 12M high of 300 mm dia at bottom and 300 mm at top having 6mm thickness. The base plate shall be 600mm x 600mm x 30mm thick with 6 Nos. Stiffner Plates and junction box including paint.
- The camera poles of 12 meters height with necessary accessories for camera mounting.
- The camera poles shall be made up of Mild steel and (hot dipped) galvanized to 100 microns thick or higher.
- Painting shall be done by means of spray after galvanization as specified by the user at the field.
- 8-M25 Anchor Bolts (Grade 8.8) and 1000mm bolt length
- The size of pole shall accommodate the loadings from Solar plates, batteries, racks and switches.
- There shall not be any joints in the poles.
- Concrete cylinder strength shall be minimum 3000psi. Sulphate Resistance cement shall be used.
- Minimum yield strength of pole and steel plate shall be 250 MPa or 36 Ksi.
- 2.5'x2.5'x9' Foundation shall be provided.

6.10. NETWORK MONITORING SOFTWARE

The basic objective of Telemetry Software or Network Monitoring Software shall be to monitor the network activity for any discrepancy, and whenever any problem or anomaly occurs in the system, it shall generates signals through light, beep or any other mean to indicate the problem. It shall indicate the potential future problem(s). Monitoring shall be performed on a dedicated machine in the Primary Data Center. A Commercial Software with the following features shall be deployed.

- Graphical visualization
- Performance Monitoring
- Devices health statistic
- Packet Inspection

- Shall automatically detect new devices on the network for monitoring including physical and virtual equipment both wired and wireless devices
- Remote monitoring feature from any location using web interface and smart phone
- Network mapping feature
- Audit trail of Network related Activities
- Support for SNMP, Telnet, ICMP, and WMI Protocols
- Setting up of custom threshold levels for emails, SMS alerts, etc.
- Dashboard and reporting facility

7. ELECTRONIC TOLL COLLECTION AND ACCESS CONTROL SYSTEM

7.1. ELECTRONIC TOLL COLLECTION SYSTEM

Electronic toll collection system shall be deployed to collect tolls with use of machine assistance and thereafter maintain primary and backup records thereof. The Toll Collection systems shall be set up as a closed loop system allowing automatic toll collection proportionate to the distance covered. Low cost reusable Magnetic Card shall be deployed for this purpose. Electronic toll collection system shall be interfaced with the Automatic Vehicle Classification (AVC) system for classification of vehicles. Information regarding the cash receipts shall be immediately communicated to the Traffic Control Center (TCC) where primary and backup data archives for the collected tolls shall be available in real time or instant viewing. Each toll booth shall be powered by the utility power supply. Electronic UPS and diesel generating sets shall provide backup power in case of loss of primary power. On the fly toll collection in the form of RFID, E-Tag facility shall also be provided. Toll booths shall allow controlled access of the Ring Road to the motorists through the use of software controlled retractable barriers

Software based traffic management shall be deployed in the control center for smooth and safe traffic flow though out the Ring Road.

7.1.1. STANDARDS

The following communications standards shall be applicable as minimum:

- Crescent HELP
- ATA 5/16/90
- ISO 10374.2
- AAR S-918-92
- ANSI MH5.1.9-1990
- ISO/TS 17573:2003 Road Transport and Traffic Telematics -- Electronic Fee
- Collection (EFC) -- Systems architecture for vehicle related transport services
- ISO/TS 14904:2002 Road transport and traffic telematics -- Electronic fee collection
- (EFC) -- Interface specification for clearing between operators
- ISO/TS14907-1:2010 Electronic fee collection -- Test procedures for user and fixed equipment -- Part 1: Description of test procedures
- ISO/TS 14907-2:2006 Road transport and traffic telematics -- Electronic fee collection Test procedures for user and fixed equipment -- Part 2: Conformance test for the onboard unit application interface
- ISO/TS 17574:2009 Electronic fee collection - Guidelines for security protection profiles
- ISO 14906:2004 Road transport and traffic telematics -- Electronic fee collection Application interface definition for dedicated short-range communication
- ISO/TS 25110:2008 Electronic fee collection -- Interface definition for on-board account using integrated circuit card (ICC)

7.1.2. LANE MONITORING

This allows the road operators to monitor current conditions of vehicle passage and operations by workers by using cameras installed in a separated lane such as a tollgate lane of the Ring Road.

7.1.3. TOLL MANAGEMENT

The toll management shall comprise of hardware and software of Lane, CCTV Monitoring Console, Printer CCTV Monitoring in Booth, Software, Data Server and Text Data indication processor which shall connect with control room, primary data center and DR data center.

Toll Booth/Roadside shall comprise of CCTV Camera Monitoring in Booth which shall integrate with the LAN server.

Functional Design

1) Lane Server

Lave server is heart of the toll collection. There are 3 kind of toll collection way, ETC, Contactless IC-Card and Manual. All toll collection way is controlled by Lane Server.

Especially, Lane Server shall be capable of calculating the Ring Road toll fee according to the toll system, based on the information from “Roadside Controller”, “IC-Card R/W” and “Toll Data Input Device”.

Also, roadside equipment are controlled by Lane Server such as “Barrier”, “Toll Due/Paid Sign”, “Entry-Card Issuer”, “Stop/Go Sign”, “Classification Sign” and “Vehicle Detector”.

2) Barrier

In case of non-stop toll collection by a vehicle is equipped On Board Unit (OBU), the vehicle speed on toll lane to be quiet higher than other vehicle. It is not only danger also difficulty make a stop the vehicle when fraud occurrence.

Therefore, in order to slowdown the speed of vehicle to under 40 km/h, when the toll billing process finish, the barrier will be lifted after a certain time lag. The time lag is difference depend on the length of toll island therefore, the time lag shall be capable of setting arbitrarily.

3) Entry-Card Issuer

The equipment component shall be capable of acceptance any technology for entry-card issue. The entry-card shall be capable of recording at least “Tollgate ID, Ticket Type, Vehicle Class, Date of issue”, it is depend on calculation of toll fee and fraud audit.

4) Detection for the counterfeited card (Transaction Counter)

(a) The system’s objective

The system objective is to install the function of “Transaction counter” in the IC card so that after each transaction of toll collection (such as ETC, Touch and Go), the value shall be added by 1 and be written in the IC card. By this process, the system shall be capable of detecting the existence of counterfeited IC.

(b) The system’s requirements

Aiming at all kind of IC-card (including Prepaid and Credit type). Whenever the billing in the ETC is implemented, the Transaction data set and the Transaction Counter, which are stored in the IC card, shall be added by 1.

Electronic toll collection system shall be deployed to collect tolls with use of machine assistance and thereafter maintain primary and backup records thereof. The Toll Collection systems shall be set up as a closed loop system allowing automatic toll collection proportionate to the distance covered. Low cost reusable Magnetic Card shall be deployed for this purpose.

Information regarding the cash receipts shall be immediately communicated to the Traffic Control Centre (TCC) where primary and backup data archives for the collected tolls shall be available in real time or instant viewing. Each toll booth shall be powered by the utility electric. Electronic UPS and diesel generating sets shall provide backup power in case of loss of primary power. On the fly toll collection in the form of RFID, E-Tag facility shall also be provided. Toll booths shall allow controlled access of the Rawalpindi Ring Road (RRR) to the motorists through the use of software controlled retractable barriers.

7.1.4. RETRACTABLE BARRIERS

A retractable barrier, or boom gates, shall be a bar, or pole pivoted to allow the boom to block vehicular access through a controlled point. The tip of a boom gate shall rise in a vertical arc to a near vertical position. Boom gates shall be counterweighted, so the pole is easily tipped. Boom gates shall be paired either end to end, or offset appropriately to block traffic in both directions. Boom gates may also have a second arm, which pivots on links that allow the second arm to hang 300 to 400 mm below the upper arm when it descends into the horizontal position, to increase approach visibility. Bidder to specify his offered type of boom gate. The retractable barrier shall be integrated with the Access Control System.

TECHNICAL DATA	**BOOM BARRIER UPTO 4.2 m**	**BOOM BARRIER UP TO 6.5M (VE.650)**
Power supply	230 Vac	230 Vac
Motor supply	24 Vdc	24 Vdc
Absorbed power	120 W	200 W
Max. absorbed current	4.5 A	8 A
Torque	130 Nm	300 Nm
Opening speed	2.5 sec	8 sec
Operation cycle	Intensive use	Intensive use
Protection level	IP 44	IP 44
Operating temp.	- 20 C/+70 C	- 20 C/+70 C
Lubrication	Grease	Grease
Weight	50 Kg	105 Kg

7.1.4.1. STANDARDS

Retractable Barriers used should comply with the following standards:

- ISO 9001
- CSA 412
- CSA 400
- CSA 402

7.2. ACCESS CONTROL SYSTEM (ACS)

The scope of work shall include the design, supply, installation, testing and commissioning of an Access Control System (ACS) and Intruder Detection System (IDS) for **Traffic Control Centre and Toll Collection Booths.** The system includes Controller, proximity Card Reader, Access Card, Electromagnetic Locks, Engineer/Operator workstation, Push Buttons, Cabinet

and Enclosures, emergency door release break glass button and Intrusion/Curtain Detectors and all associated accessories to make a fully operational with complete associated electrical and communication wiring works, control equipment, mounting brackets and accessories.

The Contractor shall be responsible for providing complete turnkey system solution including auxiliary equipment for best quality of service, and all such equipment with accessories shall be deemed to be included in the scope of Contractor and no extra payment shall be made to the Contractor for these. The Contractor shall have to visit the site to take physical dimensions of the site to verify horizontal / vertical dimensions etc. before submission of proposals. The bidders may raise the queries for any clarification, missing information or ambiguity if any, within one week after issuance of tender documents. Any work to be carried out by the Contractor, should be mentioned clearly along with the bid, otherwise no claim against extra work shall be acceptable. Specification, Drawings and BOQ etc. should be read carefully to comply with specified conditions and other general and special safety features. Any deviation from specification / BOQ should be mentioned well in time before submission of bid.

Access Control System (ACS) and Intruder Detection System (IDS) works are to be performed as per the requirements given in the specifications. The Contractor shall be responsible and provide the following:

- Provide the necessary hardware and software for above System.
- All the Major equipment of Access Control System (ACS) and Intruder Detection System (IDS) E.G Controllers, Access cards, proximity cards, electromagnetic locks, push button and emergency break glass shall be provided from the same manufacturer.

- All software packages shall be provided in original installation media along with their licenses.
- Preparing an Engineering Design Report covering, at least, the following:
  1) Detailed Drawings for the Access Control System (ACS) and Intruder Detection System (IDS).
  2) Schematics and interconnection diagrams showing Access Control System (ACS) and Intruder Detection System (IDS) components.
  3) The exact quantities and types of hardware and software required
  4) Technical details of the hardware and software of the complete systems
  5) Cable, conduit schedules and routing plans.
  6) Details of any civil works required.
  7) Detailed description of the software, user configurable functions and software features to be provided.
  8) Complete details, brochures and pictures of the proposed area.
  9) Installation, testing and commissioning procedures and methodology.
- Procure, transport and deliver equipment and hardware to site, after approval of the above report(s) by the Engineer. No payment shall be made without approval of equipment.
- Design, Install, test and commission of Access Control System (ACS) and Intruder Detection System (IDS) in accordance with the procedures given in the engineering design report. No payment shall be made without approval of design report.
- Submit Factory Acceptance Test procedures along with Schedule of Time
- Provide training to the Employer's personnel.

- Bidder shall submit with his bid the following Documents/Data for all system equipment including control equipment, Hardware Access Control System (ACS) and Intruder Detection System (IDS) and all associated accessories:
  1) Brochures and data sheets of each equipment
  2) Block diagram of the system showing interconnectivity
  3) Bill of Quantities (BOQs) as per specified format
  4) Cost breakup of each equipment
  5) Detail of Cabinets
  6) Test standards and design
  7) End user certificates
  8) International Standards Reports/Certificates

7.2.1. STANDARDS

All equipment shall be of imported origin. Materials/Equipment shall be designed, manufactured, tested and installed according to the BS/IEC/ISO/ITU/EN/CE Recommendations. The latest edition and amendments shall apply in all cases. As a minimum, following shall be applied:

a. EN 55032:2015: Electromagnetic compatibility of multimedia equipment. Emission Requirements

b. EN 61000-3-3:2013: Electromagnetic compatibility (EMC). Limits. Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems

c. EN 50130-4:2011: Alarm systems. Electromagnetic compatibility. Product family standard: Immunity requirements for components of fire, intruder, hold up, CCTV, access control and social alarm systems

d. EN 55024:2010/A1:2015: Information technology equipment. Immunity characteristics. Limits and methods of measurement

e. EN 55022:2010 Information technology equipment– Radio disturbance characteristics– Limits and methods of measurement.

The Bidder shall state in his bid the standards and codes of practice which he proposes for any items of system or equipment not covered by IEC/ISO/ITU/EN/CE Recommendations. If required by the Engineer/Employer, the Contractor shall submit two English language copies of any standard or code of practice.

7.2.2. WARRANTY

The Contractor shall provide warranty for all equipment for a period of three (03) years through authorized local distributor commencing the hand-over and acceptance date to the Employer. No equipment shall be accepted without warranty certificate from the manufacturer. It shall cover all costs for WARRANTY SERVICE, including parts replacement, labor, prompt field service, pick-up, transportation, and delivery. No extra cost shall be admissible for Warranty services.

7.2.3. FUNCTIONAL DESCRIPTION

- Field Proven (3+ years in similar environment) Access Control Systems shall be installed in all the Equipment Rooms and Management Rooms of HPP's Control Center

to ensure the safety of Control Centre Operation. The System should be able to ensure that only those individuals who obtain the requisite level of authorization can access the related area; otherwise, the access will be prohibited.

- The system shall be able to monitor and control, in real-time, the location, individual(s) accessing the protected area, time of access of the related area along with the alarm functions.
- The system shall adapt to the characteristics the requirements of multi-level management model and prompt and accurate access authorization.
- The system shall provide the open and standard interface to integrate and exchange data with other systems (if required).
- The system shall be able to independently operate.
- The access control system record shall be stored for at least one calendar year.
- Forward the Central Server Operation Commands to related Main Controller, Local Controller, Electromagnetic Locks and Card Readers.
- The Central Management System Operator shall be able to check (according to the grading and permission) or print out the data logs available.
- Access Control Terminal Operation State monitor shall be able to Check and Receive Automatically the Real-time state of access control terminal while storing all the above-mentioned data.
- The workstation at control center shall be able to graphically simulate the collocation of access control terminal, the communication status, operation status and fault(s) of various access control terminals.
- In case of illegal operation, the workstation at station level shall be able to send out alarm information in time and prompt the operator to pay special attention; the alarm must be confirmed by the operator before removal. The alarm information including the door No., controlled by access control terminal, time and alarm reasons etc. In addition, system shall be able to view the CCTV Footage from the relevant area's surveillance camera(s) in real-time.
- In case of network interruption between the control center workstation and local/main controllers, the ACS shall be able to operate normally, when the network returns to normal, it shall be able to upload data collected during the network interruption time.
- The workstation at control center shall be able to issue operation control commands to single, one group, one category or total access control terminals.
- The system will allow creation of backups for data safety and recovery.
- The following information will cause the acousto-optic alarm and display the time and alarm events in the alarm information:
    1) Device Offline or Damaged
    2) Device voltage is too low or too high
    3) Equipment was illegally opened or damaged
    4) Effort to Enter using illegal card
    5) Door open time is too long
    6) Lock relay did not move but the door is opened by force

- The system has the function of supporting the user to customize the color map display capability, which is used to display the location, the door and the lock position of the event occurrence. The layout of the access control equipment can be simulated, and the communication state, running state and fault condition of the access control equipment can be monitored graphically. When the state changes or failure occurs, the station can be displayed on the screen of the station accurately and in real time. Station work station should be able to display different colors, sound and alarm signals according to different levels of state or fault. The status of access control equipment should be able to reflect the status of different levels of information, all of the state information should be able to automatically update.

7.2.4. SYSTEM CONFIGURATION

The Central Management workstation shall be able to control the complete ACS, such as system operation, authorization, equipment surveillance and control, network management, database management, maintenance management, system data concentrated collection, statistics, storage and search. The main functions shall be as follows

- Local Control Panels shall be installed for monitoring and Control of ACS Equipment including the Controller, proximity Card Reader, Access Card, Electromagnetic Locks, Engineer/Operator workstation, Push Buttons, Cabinet and Enclosures, emergency door release break glass button.
- The Control Panel state monitor and collection of the operation data.
- The ACS Database Management
- Access control of the Authorized Area
- Access Control Card Authorization Management
- Maintenance and management to the whole access control system equipment
- Provide on-line monitor, self-diagnosis, self- restore and on-line repair functions to the system and network and display the network load
- Integration with CCTV System for real-time monitoring of Intruded/Illegal Access attempts areas
- Connection: Preferably IP TCP / or RS485

7.2.5. SYSTEM SOFTWARE

The access control systems PC or LAN application software shall support H.264 and H.265 access control software that utilizing a Windows VISTA, Server 2008, 7, 8, 10 operating system and combining point monitoring, control with integral Photo I.D. Badging, Time and Attendance, Alarm Graphics and system integration (interfacing) for CCTV, BMS, Fire, etc. The application software shall be capable of running on either a single PC or on a multi-user Local Area Network.

TCP / IP network communications shall be utilized to provide user interaction and real-time monitoring to workstations or PC's located anywhere on a LAN or WAN. The software shall be password word protected to allow for operator specific capabilities at each workstation. The access control system application software shall incorporate Point and Click operation with hierarchical tree views and popup menus for ease of use. I/O monitoring and control shall be achieved through animated icons that depict the real- time status of each input or

output. The software shall also allow I/O points to be assigned to an Override Group, allowing for multiple inputs and outputs to be monitored and controlled via a single icon.

The access control system application software shall have the ability to support and configure Graphic alarm maps and will provide detailed information regarding any I/O point within the system. The graphic maps will display real-time status of each I/O point with on-line" system monitoring through graphic objects maps and alerts and will allow the system operator to perform manual overrides directly from the map.

Photo I.D. Badging shall be integral feature of the access control application software. The system shall have the ability to import card holder images from a file, capture images from a live video source, or work with any device providing a TWAIN interface. The application software shall have the ability to print and store multiple images. Automatic Image Recall and Verification upon card use shall be an integral feature of the access control Windows, VISTA, Server 2008, 7, 8, 10 application software. The software must support signature pads, multi card access, access after operator's confirmation, elevator access control up to 50 floors, maps with system elements icon bar code and magnetic stripe encoding.

The access control application software shall provide the ability to create simple or extensive Custom History Reports, filtered event reports generation and save in *.xls format. The report function shall allow the operator to define reports by cardholder, input, output, events or any combination of these items.

The software shall be easy to install and it has very friendly graphic interface for operator. "Dynamic help" windows displayed on operator's desktop deserve attention as a handy user manual. After click in any field of operator's desktop the description of this position and configuration method of system element is displayed.

The Controllers/software with IP port shall communicate through Ethernet network. System shall support up to minimum 1024 controllers.

In case of Fire Alarm in the Station, System shall be able to cut-off the power supply to all local controllers in a unified manner and release the locked doors.

Monitoring the Operation state of Main controller, Local Controller, Card readers and Electromagnetic Locks.

7.2.6. ACCESS CONTROLLER

The minimum specifications of Controller shall be as per the following:

- No. of Inputs: 12
- No. of Outputs: 05
- Readers port: 4
- Two way control door:2
- One way control door: 4
- Relay: 3A at 24 V DC; 1A at 24V DC
- Connection: Preferably HBus of RS485
- Readers port type: Wiegand
- Card buffer: 20,000
- Event buffer: 50,000
- Supply power: 12 VDC
- Minimum Battery: 12 V / 7 Ah

- Temperature range: -10°C to 55°C
- Humidity (non-condensing): 10% - 90%
- Readers type proximity, magnetic stripe, biometric
- Inputs – wire type / max. length AWG # 22 - 300 m
- Lock output type: relay
- LED and buzzer output: 4
- Extension port: 1 x 4 relays module
- Baud rate: 19200 / 9600 bps
- Certificate: CE, FCC

7.2.7. ACCESS CARD

The minimum specifications of Access Card shall be as per the following:

- Contact less, multiple applications ISO credit card size card with high-speed read/write (13.5 MH Frequency) and data exchange with the reader as specified in ISO shall be used in the system.
- The cards shall be plain white, wiegand encoded, gloss finish on both sides and shall be directly printable on both sides.
- The Minimum cards memory shall 1K.
- The read distance of the cards using relevant proximity reader shall be up to 10 cms, with fast transaction time of less than 100 ms.
- Cards shall be constructed of laminated PVC, with data retention on temperature range of –25 Deg. C to +55 Deg. C.
- Minimum number of entry and exit points 500 nos. cards to be supplied.

7.2.8. ADMINISTRATOR PROXIMITY CARD

Administrator proximity card shall be Unique, MIFARE, HID, Prox, Reader type having operating frequency 13.56MHZ and USB interface.

7.2.9. PROXIMITY CARD READER

The minimum specifications of proximity card reader shall be as per the following:

- The system shall be equipped with keypad proximity card readers with a tamper switch as shown on the drawings. It shall be possible to use different types of cards / readers in the system.
- The Proximity Reader shall be a Uni-Directional Indoor or Outdoor unit designed for mounting on any surface including solid metal. The reader can be mounted behind most building materials such as sheet rock, or it can be mounted with its side against a metal door or window frame. This unit shall have a read range of more than 10cm.
- The Proximity Reader shall be a unitized reader with a standard Wiegand output that connects directly to the access control panel without the use of an interface module. The reader shall be designed to work with any HID / MIFARE / and Unique proximity cards.

- The card reader shall read the encoded data from the access card and/or transponder and transmit the data back to the host panel, giving an audible and visual indication of a properly read card and shall have a hold line that will buffer a card read until the panel has asserted that the information can be sent up line.
- The card reader shall have a re-present mode in which the card must be taken from the reader field for one second before being read again. This feature is required to prevent multiple reads from a single card presentation
- The reader shall be powered from the access control panel (ICP) directly.
- Operating frequency: 125 kHz, 13,56 MHz
- Read range : up to 10 cm
- Output interface : Wiegand
- Output bits : 26 or 37 (HID® Prox), 26 or 34 (Unique, MIFARE)
- Indoor /outdoor : for indoor and outdoor use
- Temperature range : -40°C to 60°C
- Humidity (non-condensing) : 10% - 95%
- Color: Black / White
- Construction: Polycarbonate/ABS/Metal
- Indications: Bi color Green/Red, Amber LED and audible tone
- Cable Requirements: Seven conductor 22 AWG shielded
- Reader Distance: Maximum 300 Meters From the Panel
- Standards: FCC and CE
- Protection Class: IP 66.

7.2.10. ELECTRO MAGNETIC LOCK

The minimum specifications of electromagnetic lock shall be as per the following;
The electromagnetic lock provided shall be suitable for single and double door type having locking sensor, door condition sensor and shall meet following minimum specifications:

- Anti-pull/Holding Force: 1100 lbs or higher (Main Door)
- Anti-pull/Holding Force: 600 lbs or higher (Sub-Building Door)
- Operating Power: 05. A at 12 V DC ; 0.25 A at 24 V DC (adjustable)
- Operation: Fail Safe (Door shall remain Open on Power failure)
- Locking: Using Internal circuitry to sense door closure.

7.2.11. PUSH BUTTON

The minimum specifications of Push button shall be as per the following:

- Contact type: NO / C
- Product Service Life: 500,000 operations
- Type of assembly: Metal
- Temperature Range: -10 to 55
- Operation Voltage Capacity: 3A / 36vdc

7.2.12. EMERGENCY DOOR RELEASE BREAK GLASS BUTTON

The minimum specifications of emergency door release break glass button shall be as per the following:

- Emergency exit button with C / NO / NC contacts
- Abrasion resistant panel with glass
- Color : Red /Green or as approved by the Engineer
- Temperature Range : -10 to 55 ˚C
- Operation Voltage Capacity : 3A / 36vdc

ROAD SIDE WEATHER INFORMATION SYSTEM

A weather information system is a combination of technologies that collects, transmits and disseminates weather and road condition information. The component of WIS that collect weather data is the Environmental Sensor Station (ESS). This station is a fixed roadway location with one or more sensors measuring atmospheric, surface and/or hydrological conditions including:

1. Atmospheric sensor – Air temperature, Barometric pressure, relative humidity, wind speed and direction, precipitation type and rate, visibility distance.
2. Surface sensor – pavement temperature and condition (Dry, Wet, Ice, Freeze point, Chemical concentration), subsurface temperature, subsurface freeze/thaw cycle
3. Roadside Controllers capable of:
   - Performing multiple tasks simultaneously to optimize data acquisition from the different environmental sensors
   - Collecting data from all sensors
   - Process, store, and transmit the data to the TCC software
4. Performing multiple tasks simultaneously to optimize data acquisition from the different environmental sensors.
5. Hydrologic sensor (Stream, river and tide level) if required
6. Data collected form Environmental Sensor in the field shall be stored on site in a remote processing unit (RPU) located in a cabinet. In addition to RPU, cabinet shall house power supply and battery backup devices. The RPU shall transmit environmental data to TCC via communication network i.e. fiber optics after every 30 minutes. WIS hardware and software shall collect field data from numerous ESS, process data to support various operational applications, and display road weather data in a format that can be easily interpreted by road user.

7.3. STANDARDS

Design and implementation of Weather Information system shall be done according to latest international standards. However, few of these standards are listed below:

NTCIP 1201 : Global Object (GO) Definitions

NTCIP 1204 : Standard for Environmental Sensor Station Interface Protocol

8. VARIABLE MESSAGE SIGN (VMS)/PASSENGER INFORMATION SYSTEM (PIS)

The VMS/PIS is an overhead sign capable of displaying standard pre-programmed aspects within a matrix of Surface Mount Device (SMD). The VMS shall incorporate dual-color lanterns using SMD matrices. VMS shall be used to provide drivers with information about congestion, incidents, speed limit, events and road safety messaging in order that drivers can make informed decisions about their journey or receive information on important national campaigns. VMS shall be preferably placed closed to the existing power and communication system to minimize cost or any other location deemed to be necessary.

Traffic status of each section shall be broadcasted to the electronic displays installed at different points. Different levels of congestion related to the routes ahead shall be shown on the displays with different colors in order to assist commuters. This system shall be implemented on important parts of Ring Road. By implanting this system in Ring Road average speed shall be improved.

8.1. STANDARDS

a) The VMS shall be Consist of Video Display with LED Panels, controllers, flicker-free display and IP65 rating with dimensions and specification mentioned below, all necessary hardware and software fulfilling the requirement in accordance with specifications and as shown on drawings, complete in all respects.

b) The proposed system shall offer state of the art range of digital LED display that provide superior image quality, extremely reliable design and long lifetime expectancy. The LED's shall be carefully controlled so that, both moving and still images are presented in the clearest possible manner.

c) The display technology shall use modular construction. The modules shall have all necessary elements required to generate the video image. LED panels shall be suitably designed so that they can be replaced from the front and rear of the screen.

d) All LED units shall have snap in place for putting display units together and allow for a HOT SWAP maintenance system.

8.2. SIZES OF VMS

The VMS Size at Gantry shall be (30x6 feet).

a) Out Door LED Display:

1. Construction: Aluminum.
2. Pixel Pitch: 10mm ± 0.5
3. Cabinet Dimensions, Width / Height (mm): 960 x 960
4. Display Service: Rear
5. Minimum brightness: 6,000 nits (cd/sm)
6. Brightness control: 100 levels
7. Contrast ratio: 1,000:1
8. Suggested horizontal viewing angle: 140° (+70/-70° off center) or higher
9. Suggested vertical viewing angle: 140° (+70/-70° off center) or higher
10. Ingress Protection Rating: IP 65 Front/ IP 54 Rear
11. Ventilation: Fan/Vent Panel
12. Working Temperature: -10 degrees to + 50 degrees C0

13. Working Humidity: 10-90%
14. Processing: minimum 14 bit
15. Color Capacity: 2.1 Trillion Colors
16. LED Refresh Rate: minimum 3,800 Hz or higher
17. LED Configuration: RGB 3-in-1 SMD
18. LED Lifetime: 100,000 hours.
19. LED shall be Nation Star / Cree / Nichia

8.3. CONTROLLER

The Media controller shall be extra-large resolution, HDMI/DVI video input and Ethernet output ports, Brightness from 0.1% to 100%, complete in all respect with the following features**.**

(i). Operating System (Window)
(ii). Display Port : 8 MP Resolution
(iii). Image Channel Simultaneous : 04
(iv). HDMI/DVI input
(v). HDMI/External audio input
(vi). 10bit/8bit HD Video Source
(vii). Output Resolution at 60Hz : 8MP
(viii). 1 Light Sensor Interface
(ix). 18-bit Grey Scale Processing and Presentation
(x). Standard 1U Housing and Independent Power Supply
(xi). Video I/O Card
(xii). Audio I/O Card
(xiii). Connectivity: Network (Ethernet , RJ-45 LAN, Fiber Optic and USB)
(xiv). Temperature (0 to 60 C0)

1.1.1 CONTROLLER WITH SOFTWARE

The controller with software in accordance to the specification including the cost of license fee (Life Time) etc. shall be complete in all respect. Features shall be as follows:

a) Software is required to provide a complete control solution and allow an operator to instantly deliver multimedia to multiple video displays, auxiliary displays and marquees through a facility. User-friendly control interface makes sending clips to displays as simple as clicking a button.
b) Playlist options to control the order of the clips. Ability to store multiple clips in a single button for quick, one-click playback.
c) Containers to allow organization of multiple clips into one button and multiple buttons into one tab.
d) Multiple transitions and effects.
e) Inline text editing.
f) Advertisements Display

8.4. MS SECONDARY STEEL STRUCTURE

The steel structure for installation of screen modules shall include all necessary arrangement including structural steel sections, nuts, bolts etc. and all other required accessories, complete in all respect. The contractor shall provide an optimum level of design and details covering all necessary requirements by the Contractor. The contractor shall submit shop drawings and calculation pertaining to structure stability and adequacy for engineer review and approval

9. TRAFFIC CONTROL CENTER (TCC), TIER-III PRIMARY DATA CENTER AND DR DATA CENTER

The Traffic Control Centre (TCC) shall be the nerve center of the Rawalpindi Ring Road (RRR) and shall house equipment (hardware, software) and personnel for monitoring, controlling and management of Ring Road traffic. The TCC shall mainly consists of the following:

1) NOC Room
2) Data Centre Room
3) Power Room
4) Generator Room
5) And other rooms as per requirement

The telecommunication backbone for the ITS shall be a modularly expandable system to cater for data video and speech requirements of the future with running out of reserve capacity.

Traffic Control Center shall be located at middle or near middle where consolidated real time information on the whole of the Rawalpindi Ring Road (RRR) would be available to the system operators. These operators shall be qualified transportation experts specifically trained to make expedient decisions for safe and efficient flow of traffic on Rawalpindi Ring Road (RRR). Because of the high speed of vehicles, the reaction time for any corrective measures is very small therefore decisions need to be taken in minimum possible time. For this ITS Master software incorporating artificial intelligence based software tools shall be deployed in future to assist the operators in the decision making process.

Modern and state of the art control center building for primary data center shall be constructed on Tier-3 power source model using architects who have expertise in global contemporary TCC centers. The primary TCC shall be housed in around 33,000 sqft. of land to be constructed with two stories and a basement having total covered area of approximately 33000 sqft. Building shall host the Tier-3 Data Center and shall be sound proof, dust proof, temperature/humidity controlled with HVAC system, etc. They would run their own BMS and have water and stabilized electricity.

Design of the TCC building shall follow the Guideline listed hereunder:

a) State of art systems shall be made part of the building envelope of primary data center building.

b) All windows shall be double glazed tempered/blast proof glass.

c) Fire rated doors shall be provided as per fire fighting codes.

d) Provision of cavity walls for insulation is recommended.

e) Entrance ramp ratio shall be as per standards.

f) Provision of electric room & HVAC Plant room shall be made.

g) Provision of ELV and ICT shall be made.

h) Provision of janitor room in female & male washrooms shall be made.

i) Internal architectural finishes and specifications including floor tiles, acoustics wall cladding and ceiling layout shall be as per international standards/practices.

j) Schedule of finishes shall be included in the design.

k) Landscaping details shall be included.

l) Furniture inventory and specifications shall be included.

m) Cable networking/trenches/cable tray/raised flooring shall be provided as per standards.

n) Provision of handicap toilet shall be included.

o) Water drainage system for the Data center shall be incorporated.

p) Provision of natural light and ventilation in the basement and other Floors shall be made.

q) Architectural composition of the Facade and Building Massing shall be designed keeping in view of local indigenous Architecture.

r) Overall 3D View showing Building map, surrounding Entry/ Exits and Parking shall be provided.

s) All these facilities shall be furnished and equipped with reasonably good quality and standard. The emergency control room shall constructed but would need to be renovated with the video wall and furnished with desk operators/office desks/other furniture.

Data Centre shall be Tier-3 level comprising redundant and dual-powered servers, storage, network links and other IT components having at a minimum of multiple independent distribution paths serving the networks and storage equipment, however, Disaster Recovery center shall be implemented in future phase of the project. In addition, the site concurrent maintainable infrastructure shall have an expected availability of 99.995%. The Data Center shall be fully secured provided with an additional layer of Authentication that eliminates the need for direct access by personnel except under extraordinary circumstances.

Data Center shall comprise of servers that include but not limited to Central/Blade Server, Video Processing Server and Video Archive Servers/Storage Area Network (SAN). The Servers housed in data center shall ensure optimum performance of the supported systems.

The design for the Data Center shall account for current and future needs including redundancy and availability, equipment racks and cabinets, telecommunication cabling, sizing and room capability, electrical system, Heating Ventilation and Air conditioning (HVAC), physical location/ architectural issues, cable containments/path ways, earthing infrastructure, automatic fire suppression, detection and fire alarms.

The Central/Blade/Video server shall consist minimum of Intel Xeon GOLD Processor or equivalent with Chassis including redundant power supplies, 10 G optical connectivity, minimum of 16 cores and 32 threads, 32 GB DDR4 RAM with upgradable facility, 4,800 GB HDD and converged Ethernet switch module for network connectivity. The Blade Server networking modules and cooling modules shall be managed via OM management modules.

The Data Centre Equipment Room shall be equipped with HVAC/Air-Conditioning System (Independent from control building), Power Distribution System including UPS, Physical Access/Security Control System, Smoke/Fire Alarm and Suppression System and Environmental Monitoring and Control. The Data Center shall be protected in a way that it ensures the fire alarms are sounded, send a predefined alarm to the local fire brigade and announce a predefined message via the Public Address for personal to evacuate the building and trigger the area fire suppression system.

All servers, switches, routers, firewalls etc. shall support monitoring using SNMP and shall have redundant power supplies. Multiple High-Speed Switched Local Area Networks (LANs) in the Data Center shall connect to Processing Machines (Systems) and Storage devices housed in the Data Center. The Data Centre infrastructure shall meet at least ANSI/BICSI 002-2014, Data Center Design and Implementation Best Practices in conjunction with TIA/EIA-568 and

ANSI/TIA-942-A. All the Servers or associated components shall be suitable to operate under the environmental conditions of temperature -20°C to 55°C and relative humidity ≤95%.

The scope of works of Control Room, Primary Data Center and DR Data Center shall include the following systems:

9.1. FIRE FIGHTING SYSTEM

9.1.1. GENERAL

All materials, components units and equipment of Fire protection system shall be designed, furnished, installed, tested and commissioned in accordance with codes and standards given in this document as well as the requirements specified. The specifications state the minimum requirements for the equipment, which shall be valid.

9.1.2. SCOPE OF SYSTEM

The scope of work comprises designing for extreme weather conditions, engineering, preparation of shop drawings, detailed software based hydraulic calculations, submission of technical submittals of all equipment and material for engineer's approval, procurement, manufacture, testing, transport, erection, installation, obtaining approvals and completion of works including relevant electrical and civil works.

9.1.3. CODES, STANDARDS AND REGULATIONS

The design and installation of the firefighting systems will follow local jurisdictional regulations and the international standards and codes of practice. The most recent approved edition of codes of practices will be applied. In case of contradiction, the one that provides more safety and/or reliability measures will be followed. Major design codes shall include: Building Code of Pakistan Fire Safety Provisions- 2016, ANSI - American National Standard Institute, ASME - American Society of Mechanical Engineers, ASTM - American Society of Testing and Material, BS- British Standards, FM - Factory Mutual Research Corporation, IBC - International Building Code, 2015 Edition, IFC - International Fire Code, 2015 Edition, NFPA 10, NFPA 13, NFPA 14, NFPA 20, NFPA 24, NFPA 25, NFPA 12, NFPA 2001.

9.1.4. BASIC DESIGN PRINCIPLE

Design of the fire protection system will be based on the codes of NFPA while the equipment shall be FM approved and UL listed in combination with the actual situation of the project. Independent water supply system for firefighting shall be adopted. Fire water pool shall be considered in design to meet the firefighting water consumption for at least 1 hour. High pressure regulation system shall also be equipped.

An electric fire pump, a diesel standby fire pump and a set of fire protection pressure stable equipment are set in the firefighting pump house. Fire Fighting Pump capacity will meet the requirement as per NPFA. The following equipment will be provided as minimum requirement :

Surge / Buffer Tank - Flow meter - Safety valves - Jockey pumps

Independent high-pressure water supply system for firefighting with pressure stable equipment will be adopted, so no high water-level fire tank should be adopted on any building roof. Fire pipes are annularly arranged in the plant, and indoor & outdoor hydrants are equipped in the buildings or on the area. Automatic sprinkler system, water spray system and extinguishing system will be adopted for complete building. Gaseous extinguishing system will be adopted in data center, battery room, UPS room, NOC/SOC room for important electrical room. Water spray system will be adopted in outdoor transformers, fire pump & its oil tank\and diesel generator as the particular fire protection measure.

Portable extinguishers/ trolleys are provided for buildings and structures in accordance with NFPA code which shall be placed at places of easy access and visibility. Fire risk classifications and fire resistance classification of building shall be according to Code for fire protection design of buildings. The distance between buildings shall be meeting the code to avoid or reduce the impact of disasters.

HDPE pipe shall be used for underground fire water main ring while all above ground piping shall be black steel pipe. All sprinklers piping system should be of hot dip galvanized type. Fire water basin will be semi-underground/ underground/ aboveground reinforced concrete structures. Fire water source will be makeup from the service water connection. System shall be compatible to integrate with Building Management System (BMS).

One fire water pump house shall be provided at the facility. One electric motor-driven fire pump, one diesel-driven standby pump and one set of fire water pressurized equipment shall be installed in the fire water pump house. Each fire water pump is provided with individual suction and discharge piping with self-priming startup mechanism. Connection piping, test piping and safety valves are set between two discharge piping for backup, scheduled fire water pump test and water return when the pressure is too high. During normal operation, pressure of fire water piping and fire water during pump startup is maintained by fire water pressurized equipment to avoid frequent pump operation. In case of a fire, when the pressure of the fire water piping cannot be maintained by pressurized equipment and the pressure drops to a certain value and the signals of water sprinkler system is sent, the fire water pump is activated. When the piping pressure continues to drop or the malfunction signal of fire water pump is sent, the diesel motor-driven pump is activated. Local control panel is installed in fire water pump house to control fire water pumps which can also be controlled from main control panel in the main control room.

Sr. No.	**Area/Service**	**Fire Protection/Suppression System**			
		Automatic Fire Water Sprinkler System	Hydrant System (Internal & External)	Portable Fire Extinguishers/ Trolleys	Automatic Gas Flooding System (Inert Gas, Clean Agent etc.)

1.	Car Parking	●	●	●	
2.	Data Centre			●	●
3.	UPS Room			●	●
4.	Battery Room			●	●
5.	NOC/ SOC Room			●	●
6.	CCTV Control Rooms			●	●
7.	Generator Set	As per NFPA Codes			
8.	Transformers	As per NFPA Codes			
9.	Main Storage Tank	As per NFPA Codes			
10.	Emergency Call Centre	●		●	
11.	Offices/Meeting Rooms	●		●	
12.	Electrical Sub-station			●	●
13.	Corridors	●	●	●	
14.	Building Periphery		●		
15.	Security Hut			●	

Qualification Criteria:
For all proposed equipment manufacturer shall meet the minimum following criteria:

- Major Fire fighting equipment shall be FM approved and UL listed.
- Minimum ten (10) years of international experience for same offered equipment.
- Minimum three (03) years national experience with local authorization representative and after sale service available in Pakistan.
- High ambient compatibility equipment.
- Most energy efficient equipment/model available in market and offered for the project.
- Testing facilities as per project requirement.
- Verifiable list of minimum five (05) projects in last five (05) years in Pakistan.
- All major parts used inside equipment like pumps, hydrants, valves etc. shall be supplied from the manufacturers' best source available in international market.
- International certificate of performance of proposed equipment/model available as per international standards.
- For Approved Equal Equipment/material, manufacturer Origin shall remain the same.

9.2. HEATING, VENTILATING AND AIR-CONDITIONING (HVAC) SYSTEM

9.2.1. GENERAL

All materials, components units and equipment of HVAC systems shall be designed, furnished, installed, tested and commissioned in accordance with codes and standards given in this document as well as the requirements specified. The specifications state the minimum requirements for the equipment, which shall be valid.

9.2.2. HVAC SCOPE OF SYSTEM

The scope of work comprises designing, engineering (Design Calculations, Design Drawings, Equipment schedules, SOPs), preparation of shop drawings, procurement, manufacture, testing, transport, erection, installation, obtaining approvals and completion of the HVAC works including relevant electrical and civil works and As-Built drawings.

- Design of compete heating, cooling, ventilation, humidity and filtration for complete building is included in scope of works.
- Eurovent/ AHRI/SASO Certified Heating, ventilation and air-conditioning (HVAC) equipment compatible to operate at -5^{o}C to 40^{o}C including VRF Units, DX Type Fresh air handling units with matching Condensing Units and Ducted type indoor units with all components and accessories.
- Duct system with diffusers, grilles, dampers, thermal insulation, acoustic liner,Sound baffles, attenuators and vibration eliminators etc.,
- Refrigerant Piping system with fittings, valves and accessories, 100% standby units shall be in all critical areas i.e. Control room, video wall area, data centers, NOC/SOC, etc.
- Protecting coats of paint and coating against corrosion and other damage for all not galvanized steel components such as steel structures,
- Fire dampers shall be provided and installed in supply and return ducts where fire zones are crossed,
- Low voltage (LV) power distribution and cabling, and earthing of all metal parts of the system
- Draining system for all HVAC equipment including all necessary accessories.
- Pressure test of Refrigerant piping system
- Functional test, starting-up, initial operation, reliability test and performance test by qualified personnel of the Contractor in the presence of the Employer or his representative,
- Provision of all necessary documents for review and approval by the Employer/Engineer before starting up and Clearing of faults and damage during the Warranty Period.

- All necessary spare parts, tools, devices, working and substitute material such as filter media, refrigerants, special detergents, oil and grease, corrosion inhibitor, fusible link, etc. for an uninterrupted, trouble free operation and to ensure fully functioning systems and to meet the latest technical experiences and standards.

- All relevant civil works including cutting, patching, repairing, masonry and concrete works, foundations, drain layout etc. is in scope of contract.

- Refrigerant pipe shall be L type with insulation a per manufacturer's recommendations and as per outdoor ambient conditions.

9.2.3. HVAC SYSTEM FOR BUILDING

The Building Shall be served with Ducted Type Indoor units/Decorative Type Units connected with VRF Type Air Conditioning System. The complete building will be provided with fresh air through separate Fresh Air units attached with matching Condensing Units. The necessary filtration in the current situation of Covid-19 shall also be provided in the fresh air handling units i.e. MERV-13 filters or higher. All critical areas including video wall, control room, NOC/SOC shall have 2 x 100% VRF units. Toilets are required to be ventilated by exhaust fans.

9.2.4. HVAC SYSTEM FOR DATA CENTRE

The data Centres shall be provided with precision Air Conditioning units/CRAC units especially designed for such areas. All the areas shall also be provided with fresh air through separate Fresh Air units attached with matching Condensing Units.The necessary filtration in the current situation of Covid-19 shall also be provided in the fresh air handling units i.e. MERV-13 filters or higher.

Note: After finalization of layout by the EPC Contractor, any area that has not been specifically mentioned in the Employer requirements shall be subject to Employer / Engineer's approval / consent.

9.2.5. CENTRAL CONTROL SYSTEMS FOR THE HVAC SYSTEMS

A LCD type controller shall be provided with VRF Units with option of fan speed, time schedule, temperature settings, mode selection, automatic storage of all settings when power off, etc.

All indoor units shall be provided with individual remote Control having features of ON/OFF, Temperature Control, Mode setting, etc.

All VRF units shall be capable to integrate with Building Management system (BMS) of the building.

9.2.6. DESIGN CONDITIONS AND DESIGN DATA

The ambient design conditions of the HVAC systems shall be as per project site climate data.

In addition, All VRF Air Conditioning System shall be designed for compatibility to operate at-5deg°Cto 40°Cambient temperature.

Design Indoor Conditions

The design indoor criteria shall be in accordance with ASHRAE standards.

9.2.7. EQUIPMENT/MATERIAL SELECTION

For all proposed equipment manufacturer shall meet minimum following criteria:

- Fifteen (15) years of international experience for same equipment /material.
- Minimum five (5) years national experience with same brand and after sale services in Pakistan
- Compliance with international standards/codes given below applicable to relevant equipment.
- Ambient compatibility (-5^{o}Cto 40^{o}C)
- Most energy efficient equipment/model available in market
- Verifiable list of projects of last five (05) years in Pakistan

9.2.8. CODES AND STANDARDS REQUIREMENTS

ASME, ASTM, ASHRAE, NFPA, ARI, SMACNA, AHRI, B.S, NEMA, P.S, TIMA, SASO codes shall be fully complied by Contractor and their offered equipment/material

Notes:

i) For all equipment mentioned above, highly efficient latest model with all safeties, controls and advanced optional features as per project requirement approved by the Employer/Engineer.
ii) All equipment shall be provided with one (03) year spare parts.
iii) Warranty period for all equipment shall be Three year
iv) HVAC equipment shall be capable to provide rated load at Outdoor Design Conditions.

9.3. ELECTRICAL WORKS

9.3.1. POWER SUPPLY

- Primary Power Source Two dedicated 11 kV Feeders (Operational + Backup)
- Secondary Power Source Diesel Generators
- Stand by Power Source Uninterruptible Power Supply

The power infrastructure for the building shall be compliant to Tier-3 level. This includes but is not limited to utility feeders, generators, UPS, transformers, distribution pathways etc.

9.3.2. PRIMARY POWER SOURCE

- Power from nearby grid station as per load demand of the site shall be taken through dedicated 11kV feeder keeping in view the applicable regulations of the relevant distribution authority/company.

- There shall be an 11kV additional dedicated feeder as backup from different Grid-Station to project site for assurance of uninterrupted prime power supply.

9.3.3. SECONDARY POWER SOURCE

Diesel Generators of appropriate rating including Auto-Mains Failure and Auto Load Transfer mechanism in N+1 redundancy to supply / generate electric power at 400V for 100% load in case of failure of 11kV utility feeders. The fueling system for the proposed generators shall be capable of continuous 72 hours operation.

9.3.4. STANDBY POWER SOURCE

This source shall maintain power to the critical load of the building in the event of the following:

- When the primary 11 kV feeder power supply fails and the redundant 11 kV feeder power supply takes over;
- When both the 11kV power supply feeders fail and the diesel generators take over.
  In the event that the diesel generators fail the UPS system shall support the critical load of building until the system can be switched down in a controlled manner.

9.3.5. 11KV SUBSTATION FOR DISTRIBUTION NETWORK

The building shall have its own sub-station at appropriate place to step down the power from 11kV to 415V.

Sub-station proposed shall have 11/0.415kV transformers of suitable rating in accordance with applicable international and WAPDA standards.

Medium Voltage (MV) switchgears and 11/0.415kV transformers shall be part of substation and installed in separate rooms. The MV metering panel shall be placed near the boundary of the building/vicinity for easy access.

9.3.6. LOW VOLTAGE (415V) DISTRIBUTION SYSTEM

The Low Voltage (LV) substation shall be capable to receive both Primary and Emergency power separately. There will be max. 30 seconds switching time from Grid to Emergency Power in case of Grid Power failure.

On LV side, onward from transformer to LV-Panels and to each floor, the compact copper bus-ways/Low voltage power cables shall be proposed. Electrical room at each floor of the building shall be provided for further power to each zone of floor. Each zone may have its independent electrical switchgear for further power distribution.

9.3.7. LIGHTING SYSTEM

Energy Efficient LED lights shall be used to achieve the required lighting level with minimized power consumption. 5 to 10% lights shall be connected on **"Central Battery System"** to provide minimum uninterrupted lighting to avoid 100% black-out during power failure.

Recommended Lighting LUX Levels:

The illumination shall be designed keeping in view the basic illumination levels in accordance with the recommendations in EN12464-1 & EN12464-2, IES and CIBSE Standards.

Lighting Control System

Local switches for lighting shall be provided at each room of the building. Parking and External lighting shall be controlled centrally from relevant distribution board with programmable intelligent remotely controlled relays. Data Centers and toilets shall have "Occupancy Sensors" with by-pass switches. Lighting Control/Dimming system and relevant equipment shall also be provided in all rooms where video walls are installed.

9.3.8. POWER RECEPTACLES

Each room shall be provided with sufficient number of socket outlets as per furniture and equipment plans for each room/area.

In order to make the work spaces utilization flexible; following shall be proposed for power receptacles/outlets:

- Simple switch socket unit, for less mission critical areas.

- Perimeter Trunking, it runs on wall and can cater numerous power receptacle and data outlets. In perimeter trunking system, both data and power cables can run in separate channels. This trunking is preferred in Data Centers, Video walls and areas of similar utilization.

- Floor Boxes, it is best suited for places required greater flexibility and generality like offices, control rooms etc.

- Power Tracks, it Manage multiple applications and provides plug and play functionality. Best suited for conference / meeting rooms.

- Linear Desk Mounted Outlets, it manages desk's small power and communication application with enhanced aesthetics.

9.4. EARTHING AND BONDING NETWORK

The grounding system design shall serve three primary functions which are listed below.

Personnel Safety:

Personnel safety is provided by low impedance grounding and bonding between metallic equipment, chassis, piping, and other conductive objects so that currents, due to faults or lightning, do not result in voltages sufficient to cause a shock hazard. Proper grounding facilitates the operation of the over-current protective device protecting the circuit.

Equipment and Building Protection:

Equipment and building protection is provided by low impedance grounding and bonding between electrical services, protective devices, equipment and other conductive objects so that faults or lightning currents do not result in hazardous voltages within the building. Also, the proper operation of over-current protective devices is frequently dependent upon low impedance fault current paths.

Electrical Noise Reduction:

Proper grounding aids in electrical noise reduction and ensures:

- The impedance between the signal ground points throughout the building is minimized.
- The voltage potentials between interconnected equipment are minimized.
- That the effects of electrical and magnetic field coupling are minimized.

Another function of the grounding system is to provide a reference for circuit conductors to stabilize their voltage to ground during normal operation. The earth itself is not essential to provide a reference function. Another suitable conductive body may be used instead.

The earth resistance value of the earthing and bonding system for building shall not exceed one ohm.

9.5. LIGHTNING PROTECTION SYSTEM

An Early Streamer Emission (ESE) Lightning Arrestor shall be provided for lightning protection of the building premises and shall be designed as per applicable international standards.

9.6. FIRE DETECTION AND ALARM SYSTEM

Intelligent Addressable Fire Alarm & Detection System shall be provided throughout the building to detect any fire at its initial stage to save human life as well as property.

An intelligent fire alarm system shall have the capability not only to detect the fire in terms of smoke, gas and heat but also point out the exact location of any such event.

It shall be a complete microprocessor based system which keeps monitoring all of its devices for proper functioning and response on each loop.

The Fire Alarm System shall be integrated with other security systems like CCTV system and Access Control System.

In Data Centers and its Power Rooms, due to high sensitive areas VESDA system (Very Early Smoke Detection Apparatus) shall be provided and integrated with Fire alarm system.

All Electrical equipment and systems shall be controlled and monitored locally and remotely by a Central Management System. All necessary hardware and software for integration of these electrical equipment and systems shall be provided.

a. IP based Video Surveillance System (CCTV System)
b. IP Based Public Address System and voice evacuation system
c. IP based PABX and Telephone System
d. Access Control System (ACS)
e. Video Conference System
f. Computer Network and Wi-Fi system
g. Biometric Attendance system and Visitor Management with Integrated Web Based Time Management
h. Video Wall and Integrated Software
i. Walk Through gate
j. Uninterrupted Power Supply System (UPS)

9.7. IP BASED VIDEO SURVEILLANCE SYSTEM (CCTV SYSTEM)

The scope of work shall include the design, supply, installation, testing and commissioning of IP based video surveillance system complete with associated electrical and communication wiring works, control equipment, Network Video Recorders (NVRs), mounting brackets and accessories. The Contractor shall be responsible for providing complete turnkey system solution including auxiliary equipment for best quality of service, and all such equipment with accessories shall be deemed to be included in the scope of

Contractor and no extra payment shall be made to the Contractor for these. The system shall include but not limited to NVRs, PTZ cameras, Outdoor/Indoor Fixed/Doom type cameras, PTZ controller, LED screens, wiring, termination, electrical boxes, and all other necessary material for a complete operating system. The contractor shall have to visit the site to take physical dimensions of hoist way, pits overhead and machine room to verify their horizontal / vertical lengths etc. before submission of proposals. The bidders may raise the queries for any clarification, missing information or ambiguity if any, within one week after issuance of tender documents. Any work to be carried out by the owner / main contractor, should be mentioned clearly along with the bid, otherwise no claim against extra work shall be acceptable. Specification, Drawings and BOQ etc. should be read carefully to comply with specified loads, serving landings and other general and special safety features. Any deviation from specification / BOQ should be mentioned well in time before submission of bid.

The CCTV System works are to be performed; the requirements given in the Technical Specification shall be fulfilled. The Contractor shall be responsible and provide the following:

- Monitoring and control of CCTV equipment in different areas.
- All the Major equipment e.g. Cameras, NVR, Poe+ Managed Switch, Client Workstation, PTZ Controller and Storage backup device shall be provided from the same manufacturer.
- CCTV Surveillance System to remotely control, Open Standard, and transmit information regarding status of each camera from the Site to Central Control Room.
- Video Display Unit (VDU) at the Central Control Room (CCR).
- Provide the necessary hardware and software for above System.
- All software packages shall be provided in original installation media along with their licenses.
- Preparing an Engineering Design Report covering at least the following subsystems:
  1) Detailed Drawings for the CCTV Camera Surveillance System showing all Coverage areas of the project.
  2) Schematics and interconnection diagrams of complete CCTV system showing CCTV surveillance system components including cameras and camera controllers and other elements to monitor and control the processes outlined above.
  3) The exact quantities and types of hardware and software required.
  4) Technical details of the hardware and software of the complete systems.
  5) Cable and conduit schedules and routing plan.
  6) Details of any civil works required.
  7) Detailed description of the data acquisition software, user configurable functions and software features to be provided.
  8) Complete details, brochures and pictures of the proposed area.
  9) Installation, testing and commissioning procedures and methodology.
- Procure, transport and deliver equipment and hardware to site, after approval of the above report(s) by the Engineer.

- Design, Install, test and commission of CCTV surveillance system in accordance with the procedures given in the engineering design report. No payment shall be made without approval of equipment.
- Submit Factory Acceptance Test procedures along with Schedule of Time
- Provide training to the Employer's personnel.
- Bidder shall submit with his bid the following Documents/Data for all system equipment including PTZ camera, fixed/Doom camera, NVR, Network Data Switch, SFP module, Power Injector UPS, Batteries:
  1) Brochures and data sheets of each equipment.
  2) Block diagram of CCTV system including OFC showing interconnectivity of all CCTV equipment including connection of cameras, NVR, Data Switches and LED Video display unit with LAN.
  3) Detail of Cabinets.
  4) Field of view showing coverage area of each camera.
  5) Test standards and design.
  6) Backup calculations showing that Hard Disks shall be able to record data of all cameras for a period of one Month.
  7) End user certificates.
  8) International Standards Reports/Certificates

9.7.1. STANDARDS

All equipment shall be of imported origin. Equipment design and manufacturing shall be only from Europe, USA and/or from the list of mentioned brands at the end of these specifications. Materials/Equipment shall be designed, manufactured, tested and installed according to the BS/IEC/ISO/ITU/EN/CE Recommendations. The latest edition and amendments shall apply in all cases. As a minimum, following shall be applied:

a) EN 55022:2010 Information technology equipment– Radio disturbance characteristics– Limits and methods of measurement.
b) EN 60950-1:2006/A11:2009/A1:2010/A12:2011/A2:2013 Information technology equipment – Safety – Part 1: General requirements.
c) EN 55032:2015 Electromagnetic compatibility of multimedia equipment – Emission requirements.
d) IK 10, BS EN 62262:2002: Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code).
e) BS EN 61000-3-3:2013: Electromagnetic compatibility (EMC). Limits. Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems.
f) EN 55024:2010+A1:2015: Information technology equipment. Immunity characteristics. Limits and methods of measurement.
g) EN 61000-3-2:2014: Electromagnetic compatibility (EMC). Limits. Limits for harmonic current emissions.

9.7.2. GENERAL SPECIFICATIONS

- Proposed CCTV system shall be an open standard based integrated system with IP network centric functional and management architecture aimed at providing high-speed manual / automatic operation for best performance.
- System shall use video signals from various types of indoor/outdoor CMOS color cameras installed at different locations, process them for viewing on workstations/monitors at Central Control Room and simultaneously record all the cameras after compression using H.264/H.265 or better standard. Joystick or Mouse-Keyboard controllers shall be used for Pan, Tilt, Zoom, and other functions of desired cameras.
- System shall have combination of CMOS Color Video Cameras with individual IP address with Fixed or P/T/Z Lens, Network Video Recorders (NVR/CAMERA SERVER), Storage for recording, Application software, Color Video Monitors, Keyboards with Joystick controllers.
- Mouse-Keyboard, software based Video Matrix Switcher, workstation for System Administration / Management / Maintenance etc.
- Network Video Recorder shall offer both video stream management and video stream storage management. Recording frame rate & resolution in respect of individual channel shall be programmable.
- System should ensure that once recorded, the video cannot be altered; ensuring the audit trail is intact for evidential purposes.
- System shall provide sufficient storage of all the camera recordings for a period of one month or more @ 30 FPS, at H.265, H.264, MPEG or better quality using necessary compression techniques for all cameras (extended capacity of cameras i.e. present capacity + 25 %).
- System shall use a combination of IP enabled fixed and PTZ cameras. The video shall be compressed using H.265, H.264 / MPEG-4 or better standard and streamed over the IP network.
- The recording resolution and frame rate for each camera shall be user programmable.
- The Area under surveillance shall be monitored and controlled from Central Control Room(s) through workstations and Joystick controllers.
- Power for all the equipment will be conditioned using on-line UPS with minimum 120 minutes or more back up. If any equipment operates on any voltage other than the supply voltage and supply frequency, necessary conversion/correction device for supply shall be supplied along with the equipment.
- All the Major equipment e.g. Cameras, NVR, PoE+ Managed Switch, Client Workstation, PTZ Controller and Storage backup device shall be provided from same manufacturer.
- Cameras shall be installed on poles/walls as per requirement. Poles of 5m and 7m shall be installed.

9.7.3. SYSTEM REQUIREMENTS

- Fixed focus IP cameras shall be 5MP resolution with Motorized lens as per site requirement with IP66 environmental aluminum enclosure.

- PTZ cameras shall be 3MP resolution with varifocal lens, high SNR, IR, wide dynamic range, 30x optical zoom and true day/night feature with weather proof aluminum enclosure.
- Outdoor camera housing shall be of IP 66 or better rating. These must be integrated by the camera manufacturer.

• System must provide built-in facility of watermarking or Digital certificate to ensure tamperproof recording so that these can be used as evidence at a later date, if so desired.

• All camera recordings shall have Camera ID & location/area of recording as well as date/time stamp. Camera ID, Location/Area of recording & date/time shall be programmable by the system administrator with User ID & Password.

• Facility of camera recording in real-time mode (30 FPS)/15/12.5/10 or lower FPS as well as in any desired combination must be available in the system.

• System to have facility of additional camera installation beyond the originally planned capacity.

• In order to optimize the memory, while recording, video shall be compressed using H.265, H.264 or better standard and streamed over the IP network.

• System shall be triplex i.e. it should provide facility of Viewing, Recording & Replay simultaneously.

• The offered system shall have facility to export the desired portion of clipping (from a desired date/time to another desired date/time) on CD or DVD or USB Storage. Viewing of this recording shall be possible on standard PC using standard software like windows media player etc.

• System shall have provision of WAN connectivity for remote monitoring.

9.7.4. FIELD OF VIEW SHOWING COVERAGE AREA OF EACH CAMERA

The following field of view details shall be provided:

• Computes Field of View seen by camera and lens, for any sensor size or aspect shape (film or digital).

• Computes both the dimensional size of the Field of View seen at a specified distance, and also Angle of View (degrees, which is independent of distance) using software.

• Field of view shall use computing dimensional field of view size at some specific distance, like at the subject distance.

9.7.5. WARRANTY

The Contractor shall provide warranty for all equipment for a period of three (03) years through authorized local distributor commencing the hand-over and acceptance date to the Employer. No equipment shall be accepted without warranty certificate from the manufacturer. It shall cover all costs for WARRANTY SERVICE, including parts replacement, labor, prompt field service, pick-up, transportation, and delivery. No extra cost shall be admissible for Warranty services.

9.7.6. FUNCTIONAL / EQUIPMENT DESCRIPTION

9.7.6.1. PAN/TILT/ZOOM CAMERA (PTZ CAMERA)

The PTZ Camera should have the following features: The camera should be IP based

Image

- Image Sensor 3 MPX CMOS sensor 1/2.8”
- Number of Effective Pixels 2065 (H) x 1553 (V)
- Min. Illumination 0.07 lx/F1.6 - color mode, 0.007 lx/F1.6 - B/W mode,
- Electronic Shutter auto/manual: 1/5 s ~ 1/20000 s
- Digital Slow Shutter (DSS) up to 1/5 s
- Wide Dynamic Range (WDR) (double scan sensor), 120dB
- Digital Image Stabilization (DIS) Digital Noise Reduction (DNR) 2D, 3D
- Defog Function (F-DNR)
- Highlight Compensation (HLC)
- Back Light Compensation (BLC)

Lens

- Optical Zoom 30x
- Lens Type motor-zoom, auto-iris function, f=4.5 ~ 135 mm/F1.6 ~ F4.4
- Auto-focus continuous, zoom trigger

Day/Night

- Switching Type mechanical IR cut filter
- Switching Mode auto, manual, time
- Visible Light Sensor

Network

- Stream Resolution 2048 x 1536 (QXGA), 1920 x 1080 (Full HD), 1280 x 720 (HD).
- Frame Rate 30 fps for 2048 x 1536 (QXGA) and lower resolutions
- Multi streaming Mode 3 streams
- Video/Audio Compression H.264, H.264+, H.265, H.265+, MJPEG/G.711
- Number of Simultaneous Connections max. 8
- Network Protocols Support HTTP, TCP/IP, IPv4, IPv4/v6, UDP, HTTPS, FTP, DHCP, DNS, DDNS, NTP, RTSP, RTP, UPnP, SNMP, PoE, RTCP
- ONVIF Protocol Support Profile S/Q

PTZ

- Preset Commands 400
- Tilt/Pan Range 0° ~ 98°/360° (continuous)
- Pan/Tilt Speed up to 180°/s (proportional to zoom)
- Privacy Zones 4 video mask
- Motion Detection Region of interest (ROI) 6
- Video Intelligence Analysis (VIA) Auto Tracking, zone entrance detection and object tracking
- Image Processing 180˚ image rotation, sharpening, mirror effect
- System Reaction to Alarm Events e-mail with attachment, saving file on FTP server, alarm output activation, PTZ

IR LED

- Range up to 200 m

Interfaces

- Audio Input / Output Bidirectional Audio Transmission

- Alarm Input / Output

Protection

- Degree of Protection IP 66
- Enclosure Aluminum, outdoor housing
- Power Supply High POE.
- Operating Temperature -30°C ~ 60°C
- Built-in Heater/Fan

9.7.6.2. IP BASED INDOOR DOME CAMERA

The indoor fixed camera should have the following features:

IMAGE

- Image Sensor 5 MPX CMOS sensor 1/2.7”
- Number of Effective Pixels 2592 (H) x 1944 (V)
- Min. Illumination 0.017 lx/F1.4 - color mode, 0 lx (IR on) - B/W mode
- Electronic Shutter auto/manual: 1/3 s ~ 1/100000 s
- Digital Slow Shutter (DSS)
- Wide Dynamic Range (WDR) (double scan sensor), 120dB
- Digital Noise Reduction (DNR) 2D, 3D
- Defog Function (F-DNR)
- Highlight Compensation (HLC)
- Back Light Compensation (BLC)

LENS

- Lens Type motor-zoom, f=2.8 ~ 12 mm/F1.4
- Auto-focus zoom trigger, day/night mode trigger

DAY/NIGHT

- Switching Type mechanical IR cut filter
- Switching Mode auto, manual, time
- Visible Light Sensor

NETWORK

- Stream Resolution 2592 x 1944, 2592 x 1520, 2560 x 1440 (QHD), 2304 x 1296,
- 1920 x 1080 (Full HD)
- Multi streaming Mode
- Video/Audio Compression H.264, H.264+, H.265+, G.711
- Network Protocols Support HTTP, TCP/IP, IPv4, IPv4/v6, UDP, HTTPS, Multicast,

FTP, DHCP, DDNS, NTP, RTSP, SNMP, QoS, IEEE 802.1X, PPPoE,

- ONVIF Protocol Support Profile S/G
- Mobile applications Live Plus (iPhone, Android)

OTHER FUNCTIONS

- Privacy Zones video mask type
- Motion Detection
- Region of interest (ROI)
- Facial Recognition Advance analytic Function
- Video Intelligence Analysis (VIA)

o tamper,

- o abandoned object,
- o object disappearance,
- o line cross,
- o zone entrance,
- o object counting,
- o multi loiter,
- o face detection,
- o Scene Change,
- o Video Blurred,
- o Video Color Cast

• System Reaction to Alarm Events e-mail with attachment, saving file on FTP server, saving file on SD card

IR LED

• Smart IR Range 50 m

INTERFACES

• Audio Input / Output with built-in microphone
• Memory Card Slot microSD - capacity up to 128GB

Protection

• Degree of Protection IP 67
• Enclosure vandal proof IK10 impact rating aluminum
• Power Supply POE
• Operating Temperature -30°C ~ 60°C

9.7.6.3. IP BASED OUTDOOR FIXED BULLET CAMERA

The outdoor fixed camera should have the following features:

Image Sensor

• 5 MPX CMOS sensor 1/2.7”
• Number of Effective Pixels 2592 (H) x 1944 (V)
• Min. Illumination0.017 lx/F1.4 - color mode,0 lx (IR on) - B/W mode
• Electronic Shutter auto/manual: 1/3 s ~ 1/100000 s
• Wide Dynamic Range (WDR) (double scan sensor), 120dB
• Digital Noise Reduction (DNR) 2D, 3D
• Defog Function (F-DNR)
• Highlight Compensation (HLC)
• Back Light Compensation (BLC)

LENS

• Lens Type motor-zoom, f=2.8 ~ 12 mm/F1.4
• Auto-focus zoom trigger, day/night mode trigger

DAY/NIGHT

• Switching Type mechanical IR cut filter
• Switching Mode auto, manual, time

NETWORK

• Stream Resolution 2592 x 1944, 2592 x 1520, 2560 x 1440 (QHD), 2304 x 1296, 1920x 1080 (Full HD)

- Multi streaming Mode
- Video/Audio Compression H.264, H.264+, H.265+, G.711
- Network Protocols Support
- HTTP, TCP/IP, IPv4, IPv4/v6, UDP, HTTPS, Multicast, FTP, DHCP, DDNS,
- NTP, RTSP, SNMP, QoS, IEEE 802.1X, PoE.
- ONVIF Protocol Support Profile S/G

OTHER FUNCTIONS

- Privacy Zones video mask type
- Motion Detection
- Region of interest (ROI)

Video Intelligent Analysis (VIA)

- o tamper,
- o abandoned object,
- o object disappearance,
- o line cross,
- o zone entrance,
- o object counting,
- o multi loiter,
- o face detection,
- o Scene Change,
- o Video Blurred,
- o Video Color Cast
- System Reaction to Alarm Events
- Face Recognition Advance analytic Function
- e-mail with attachment, saving file on FTP server, saving file on SD card

IR LED

- Smart IR Range 50 Meter

INTERFACES

- Audio Input / Output
- Memory Card Slot microSD - capacity up to 128GB

INSTALLATION PARAMETERS

- Degree of Protection IP 67
- Enclosure aluminum, with wall mount bracket in-set
- IK10 impact rating
- Power Supply POE,
- Operating Temperature -30°C ~ 60°

9.7.6.4. PTZ CONTROLLER

PTZ Controller shall have variable speed joystick, LED display for programming and it shall be able to control the speed for PAN/TILT/Zoom. It shall be able to control cameras utilizing N-Control and Pelco-D protocols. Keyboard shall have three (3) level accesses: ADMINISTRATOR, SUPERVISOR and USER. It shall also have control of up to 256 cameras.

9.7.6.5. NETWORK VIDEO SERVER/PROCESSOR AND STORAGE/RECORDER

The Network Video Server/Processor and Storage/Recorder shall be optimized to view, store, manage and analyze real-time and recorded video in a networked environment. The system shall provide a highly scalable and reliable platform to support customized and network-based surveillance applications. The Network Video Recorder shall support 4K Ultra HD resolution (12MP) , H.264/H.264+, H.265/H.265+, any specified frame rate, VMS (Video Management System), ability to schedule operator shifts, event filters, temporary views and The Open Network Video Interface Forum (ONVIF) while simultaneously supporting 3rd party IP based cameras from a variety of different vendors.

The system shall display any combination of live and recorded camera feeds on multiple workstations simultaneously using an IP network. The system shall provide a Management Console /dashboard that shows the status of Memory, Disk Usage, and traffic analysis. The system shall provide for integration with other software applications through an open and video analytics. The system shall support simultaneous video feeds including sub-streams minimum of five from each camera across multiple locations for centralized and decentralized storage, display, and distribution of video without limitation.

The system shall allow instant replay of video and shall permit pausing of live video, forward and backward review of recorded video, and return to live viewing. The system shall provide flexible archiving capability in terms of frame rate, duration, and location and shall utilize dynamic file allocation to ensure that the full duration of the selected video stream shall be recorded, regardless of lighting condition, motion, or scene detail.

Loading of all Servers shall not be more than 60 - 70%. The Network Video Server/processor and Storage/Recorder shall be certified from an international standard i.e. Chartered Engineers (CE) Europe, Federal Communications Commission USA (FCC), etc. All the Servers or associated components shall be suitable to operate under the environmental conditions of temperature -20°C to 55°C and relative humidity ≤95%.

NVR shall have following features

- Supported protocols: ONVIF, RTSP
- Supports resolution up to 4000 x 3000
- Recorded stream size: 250 Mb/s in total from all cameras
- Supports up to 3 monitors simultaneously
- disk mounting: 8 x S-ATA 3,5 or higher"
- Operating system: Microsoft Windows 10 IoT
- Recording and surveillance system: VMS (Video Management System)
- Integration with Access Control System.

The system shall provide the following administrator functionalities:

- Secure login
- Server, encoder, and camera administration
- Scheduled and event-based video recording
- User and role management
- Fine-grained activity reports and system audit
- Ability to push pre-defined views to any number of digital monitors with Virtual Matrix
- Ability to schedule to operator shifts, event filters, temporary views

9.7.6.6. STORAGE REQUIREMENTS

- Recording of all the camera streams must be stored for the period of one month.
- The storage media must be SATA drive.
- The supplier/ contractor to confirm the storage requirement as per number of cameras, pixel resolutions, video compression and number of 30 recording days.

9.8. IP BASED PUBLIC ADDRESS SYSTEM AND VOICE EVACUATION SYSTEM

The scope of work shall include the design, supply, installation, testing and commissioning of IP Public Address (PA) and Voice evacuation System complete in all respect. Contractor shall supply installation, test and commission a Back-ground Music / Public Address system comprising of Amplifiers, loudspeakers and all necessary cabling and termination. The system shall be generally as indicated on the drawings and as herein specified, to the approval of the Engineer. The Contractor shall be responsible for providing complete PA system solution including auxiliary equipment for best quality of service and all such equipment shall be deemed to be included in the scope of Contractor.

The complete system shall be supplied by a specialist Subcontractor having at least five years' experience in the field. All equipment supplied shall be from one reputed manufacturer and shall be installed by the authorized representative of the manufacturer. All the equipment included in this system shall be covered by manufacturer's warranty for minimum three years. All bidders shall have to visit the site to take physical dimensions of hoist way, pits overhead and machine room to verify their horizontal / vertical lengths etc. before submission of proposals. The bidders may raise the queries for any clarification, missing information or ambiguity if any, within one week after issuance of tender documents. Any work to be carried out by the owner / main contractor, should be mentioned clearly along with the bid, otherwise no claim against extra work shall be acceptable. Specification, Drawings and BOQ etc. should be read carefully to comply with specified loads, serving landings and other general and special safety features. Any deviation from specification / BOQ should be mentioned well in time before submission of bid.

For the purpose of Public Address System the speakers are grouped into different zones as follows;

a) Corridors and Passage
b) Parking

Different level of priorities as per following shall be allotted to different signals for transmission through same speaker.

a) Emergency announcements highest priority
b) Fire tone next
c) Music Least

All control consoles shall be placed in the Control / Management Room. Announcement shall be played from the Control / Management Room.

The announcement shall be made in individual mode (i.e. one zone at a time) or to multiple zones at a time.

The SOP can vary subject to the requirement of Chief Operating Officer. This shall be specified at the time of Completion of Commissioning and is included in part of vender software and hardware programming.

The IP Public Address (PA) and Voice evacuation System works are to be performed; the requirements given in the Technical Specification shall be fulfilled. The Contractor shall be responsible and provide the following:

- Monitoring and control of IP Public Address (PA) and Voice evacuation System equipment in different areas.
- All the Major equipment e.g. Network Controller, Power Amplifier, Power Supply Manger, Speakers and Storage backup device shall be provided from the same manufacturer.
- Video Display Unit (VDU) at the Central Control Room (CCR).
- Provide the necessary hardware and software for above System.
- All software packages shall be provided in original installation media along with their licenses.
- Preparing an Engineering Design Report covering at least the following subsystems:

1) Detailed Drawings for the IP Public Address (PA) and Voice evacuation System showing all Coverage areas of the project.
2) Schematics and interconnection diagrams of complete IP Public Address (PA) and Voice evacuation System showing PA system components including Network Controller, Power Amplifier, Power Supply Manger, Speakers and other elements to monitor and control the processes outlined above.
3) The exact quantities and types of hardware and software required.
4) Technical details of the hardware and software of the complete systems.
5) Cable and conduit schedules and routing plan.
6) Details of any civil works required.
7) Detailed description of the data acquisition software, user configurable functions and software features to be provided.
8) Complete details, brochures and pictures of the proposed area.
9) Installation, testing and commissioning procedures and methodology.

- Procure, transport and deliver equipment and hardware to site, after approval of the above report(s) by the Engineer.
- Design, Install, test and commission of Network Controller, Power Amplifier, Power Supply Manger, Speakers in accordance with the procedures given in the engineering design report. No payment shall be made without approval of equipment.
- Submit Factory Acceptance Test procedures along with Schedule of Time
- Provide training to the Employer's personnel.

Bidder shall submit with his bid the following Documents/Data for all system equipment including Network Controller, Power Amplifier, Power Supply Manger, Speakers UPS, and Batteries:

- Brochures and data sheets of each equipment
- Block diagram of IP Public Address (PA) and Voice evacuation System including OFC showing interconnectivity of all equipment.

- Detail of Cabinets.
- Field of view showing coverage area of each speaker.
- Test standards and design.
- Backup calculations showing that Hard Disks shall be able to record data on workstation of all system for a period of one Month.
- End user certificates.
- International Standards Reports/Certificates

9.8.1. STANDARDS

All equipment shall be of imported origin. Equipment design and manufacturing shall be only from Europe, USA and/or from the list of mentioned brands at the end of these specifications.

9.8.2. WARRANTY

The Contractor shall provide warranty for all equipment for a period of three (03) years through authorized local distributor commencing the hand-over and acceptance date to the Employer. No equipment shall be accepted without warranty certificate from the manufacturer. It shall cover all costs for WARRANTY SERVICE, including parts replacement, labor; prompt field service, pick-up, transportation, and delivery. No extra cost shall be admissible for Warranty services.

9.8.3. MATERIALS AND EQUIPMENT

a) Furnish and install at locations shown the specified equipment, to provide a completely operational Digital Public Address System.

b) Provide and install all equipment, components, cable and mounting hardware as required to meet manufacturer's specifications and documented installation procedures.

c) All materials and equipment shall be standard, regularly manufactured equipment. All systems and components shall be thoroughly tested and proven in actual field use. Where possible, all system components shall be from one manufacturer. Whenever components are included from sources other than the manufacturer of the system, the CONTRACTOR shall demonstrate and verify that the components are compatible, prior to system acceptance, and shall provide to the CUSTOMER that use of such components will not void or impair the system warranty.

Where required, provide 220 VAC, 50 Hz power from nearest electrical panel, through a junction box, to the system equipment.

Test for ground loops that may result from use of different power sources for various components.

All items of public address system shall be listed product of a single manufacturer.

Contactor or vendor must provide all operation and maintenance manual of the offered system.

Normal instruction should be mentioned in black color and emergency instructions or important notes must be in Red color.

Each and every software, firmware, hardware updates will be provided free of cost in the warranty and maintenance contact period.

9.8.4. SYSTEM OVERVIEW

- The Digital Public Address System shall be a highly sophisticated, microprocessor controlled and modular unit.
- It shall be built around 19 inch rack mounted Euro card circuit boards where the configurations can be tailored and expanded to meet every need precisely.
- The supply of the Digital Public Address System shall include, but not limited to the following:

a) Recessed mount (ceiling) speakers, sound projectors c/w line matching transformers and central alarm controller, power amplifiers, call stations, where applicable;

b) Equipment rack complete with forced air ventilation fan(s), mounting brackets blank panels, terminal boards, etc.

- All routing, switching and priority functions shall be easily programmed and changed by non-technical personnel.
- It shall accept input signals from call stations, microphones, music sources, pre-recorded message source, etc.
- The primary objective of the system is to provide clear announcements during public addressing and one-way voice communication during an emergency, the secondary function shall be to provide background music where required.
- The loudspeakers shall be wired up in zones and with supervision; localized volume controls as specified shall be provided so that the desired volume adjustments may be made
- The zones shall further be grouped according to function so that it shall be possible to make an announcement by pressing just one switch on the call station.
- To allow flexibility in the system, it shall be designed to be expandable with easy installation without changes in controller.
- When the zones are selected for public addressing, a chime shall first be heard, followed by the announcement. The system shall have a range of tones such that it shall be possible to program different tones for call stations.
- The system shall comply with country Public Address Evacuation Code of practice for the one-way emergency voice communication system in all aspects.
- The PA system shall be the integrated solution for BGM and emergency voice alarm system (EVAC). The voice alarm system shall be modular & digital, designed for public address and emergency evacuation. All the essential EVAC functionality – such as system supervision, spare amplifier switching, loudspeaker line surveillance, digital message management and a fireman's panel interface – shall be combined.

9.8.5. DIGITAL MATRIX SYSTEM

- The Digital Matrix System shall have a RJ 45 network interface for hybrid cabling with dual network connections with DSP. The network interface of the network controller shall support digital audio and control signals.

- The network controller shall be a control unit for a public address and emergency sound system. It shall control and route up to 16 Input and 16 output simultaneous audio channels on network, with audio signals comprising e.g. announcements made via call stations or background music from a connected CD-player.
- The network controller shall have an RJ-45 Ethernet connection for connecting a configuration PC, directly or via an Ethernet network. After the configuration the network controller shall be able to run stand-alone without PC, although it shall be possible to keep the network controller connected to the network or PC for additional functions, such as logging of call and fault events or remote control.
- The network controller shall provide power to connected equipment on the network.
- It shall provide 16 analog audio input channels that can be routed dynamically to the network. Of these, two shall be selectable between microphone and line use. In microphone mode the unit shall provide configurable phantom power supply to support electret/ condensor microphones. It shall be possible to configure the inputs as call inputs with dedicated characteristics such as priority, pre- and post-chimes, prerecorded messages and live speech. It shall also provide 4 analog audio output channels to which network audio channels can be routed dynamically. All audio inputs and outputs shall have (RCA) connectors.
- The DSP shall include treatment of channels in mono or stereo mode, level, mute and phase adjustment in inputs and outputs, polarity test , 8 band parametric EQ, delays, noise gate, compressor on input channels, compressor / limiter on outputs, 4 priority levels (ducking) between input channels, and management of 2 physical paging consoles.
- The network controller shall contain a digital audio processor that performs audio input sensitivity control, 8-band full parametric equalization and semi parametric shelving equalizers for bass and treble control for each input and output, and volume control and 20 kHz supervision pilot tone generation for all audio outputs. It shall be possible to remotely configure all audio settings via the network interface.
- The network controller shall have a supervision system to monitor its operation conditions. Network connectivity status and fault conditions of the network controller itself and all network connected units shall be stored inside the network controller.
- The network controller shall have 16 control outputs, that can be configured for various functions, such as fault indication or zone activity indication, and 16 control outputs dedicated for visual and audible fault indicators.
- The Digital Matrix System shall comprise of 8 independent controllable output zones, 8 audio inputs, containing 4 balanced microphone inputs with priority function and phantom power possibility, and 8 remote audio inputs with RJ45 connection. Remote management shall be available via mobile devices. Remote control from third-party systems shall be available using TP-NET control protocol through Ethernet o RS-232 ports. The Digital Matrix System shall have an integrated webserver on which a fully functional web-based user interface, which shall be accessed through a web browser.
- The network controller shall provide an Open Interface, that allows for control of the system by a third party device over Ethernet TCP/IP.
- The network controller shall have maximum16 Number of outputs.

- The network controller shall have connector type / kind of fiber: Multimode or single-mode.
- The network controller Input impedance shall be ≥ 20 k.
- The network controller Frequency response shall be 500 Hz – 8 kHz The network controller Harmonic distortion shall be (THD+IMD) ≤ 0.05%.
- The network controller Finish Case Material shall be Steel or better.
- The network controller shall be certified by an independent test agency for compliancy to the international standard IEC for emergency sound systems and EN Certified System.
- The network controller cabinet shall be 19”-wide for easy rack mounting without the need for free rack space between units.

9.8.6. DIGITAL SYSTEM SOFTWARE

- The software for the networked sound system shall consist of separate sections for configuration, diagnostics and logging, and file transfer.
- The configuration software part shall consist of a web server inside the network controller that allows the configuration settings to be made via a standard web browser. It shall support three access levels: administrator, installer, and user, each with different access rights.
- The configuration software shall support the assignment of all system units in a system and the individual configuration of each unit.
- The configuration software shall support call macros to allow users to configure various functions and/or actions that can be assigned to inputs such as control inputs and call station keys. It shall be possible to assign the same call macro to multiple inputs. A call macro shall define one or more of the following: priority, start and end tones with volume setting, an audio input for live speech insertion with volume setting, a message or sequence of messages with a number of repetitions and volume setting, maximum call duration, its routing scheme (partial, non-partial, stacked) and its timing scheme.
- The configuration software shall support zone definition and zone grouping. In zone configuration, it shall be possible to assign zone-related items such as amplifier channel outputs, audio outputs and control outputs to defined zones.
- The configuration software shall support spare power amplifier configuration and assignment, where a power amplifier can be linked to a spare power amplifier so that if there is a fault in the power amplifier, its load will automatically change over to the spare power amplifier. The number of main power amplifiers that share the same spare power amplifier shall be flexible.
- The configuration software shall configure all equipment inputs and outputs in the system, including audio processing functions and operation modes.
- The configuration software shall configure keys on call station keypads or control inputs with various functions, such as zone selection, priority selection, message selection, tone selection, call (macro) activation, BGM selection, BGM volume control, control output switching, user defined fault generation, fault status acknowledge and/or reset, emergency status acknowledge and/or reset, recall and cancel. Control inputs can be configured for monitoring lines connected to them for open circuits and short circuits.

- It shall be possible to configure various time-based volume settings for BGM and calls in a zone. The configuration software shall support the assignment of BGM sources to music channels, which can be assigned to different zones.
- The diagnostic and logging software part shall support different modes of enquiry, including general events, call events, and fault events. This part of the software shall allow for monitoring the fault status of all units, as well as any status changes in the system. Users shall be able to view the last 200 fault messages, which are stored in the network controller. It shall be possible to use control inputs to report the fault status of third-party equipment, allowing users to view logged events of monitored external devices. The software also shall provide control of audible and visual fault indicators. It shall be possible to acknowledge and reset faults and alarm states, and to log these actions.
- A PC-based logging server shall be available that can store an almost infinite number of call events, general events and fault events from multiple systems in a database. This database can be accessed remotely by one or more dedicated log viewer programs. This log viewer program shall be able to browse through recent and/or past events, to sort and print these events, and to acknowledge and reset fault events.
- The system software shall be certified by an independent test agency for compliancy to the standards EN.

9.8.7. BASIC CALL STATION

- The basic call station shall have an CAT-6 based connection to a call station interface unit, which in turn shall be connected to an audio and control network, based ON hybrid cabling. Via the call station interface unit, the basic call station shall be able to receive audio and operational control signals from the network and report its status to the system controller. It shall be possible to connect the basic call station to the call station interface via a CAT-6 cable of up to 500 m. The CAT-6 cable shall carry the audio and control signals in digital format.
- The call station shall use a cardioid, supervised microphone on a gooseneck stem with good speech intelligibility. It shall have a limiter and a speech filter to improve speech intelligibility and prevent clipping of the audio signal.
- Basic call station shall have push to talk button.
- It shall have a monitoring loudspeaker with volume control and jack connection for a headset. Insertion of the headset connector shall automatically disconnect and replace the gooseneck microphone and internal loudspeaker. The chime and pre-recorded message parts of a call shall be audible via the loudspeaker or headset for monitoring by the operator.
- The Call station shall have Programmable Keys and it shall be possible to connect up to 20 call station keypads modules to the call station via a serial communication link. The call station shall provide the power supply for the keypads. The connected keypads shall provide various selection options for the call station.
- The Call station shall have Input, connector type RJ 45.
- The call station shall be remotely configurable via the network interface and it shall be powered from the network for easy installation or from an external power supply.

- The call station shall have a supervision system to monitor its functions and operation in compliancy to EN. Network connectivity status, operation status and fault conditions shall be displayed via LEDs on the unit. Fault conditions shall also be reported by the unit to a network connected system controller for logging purposes.
- The call station shall support fail-safe operation, i.e. even if the controller of the audio system fails, the call station is still able to put through emergency calls to all audio outputs on the network.
- The unit shall be able to operate at a maximum operating temperature of 40°C.

9.8.8. SYSTEM POWER AMPLIFIERS (600W)

- The 4-channel Class-D amplifiers having EN Standard. The network interface of the amplifiers shall support digital audio and control signals.
- The amplifier shall contain a digital audio processor with noise dependent automatic volume control (AVC) function that can be remotely configured via the network interface.
- The system shall operate at 220 Vac on Normal condition.
- The amplifier shall contain 4 analog audio inputs, supporting line and microphone levels, for noise sensing microphones or auxiliary audio sources. The sensitivity and operation mode of these inputs shall be configurable via the network interface.
- The power amplifier shall be provided as per distribution and drawings. It shall be able to deliver rated power at a maximum operating temperature of 40°C to accommodate high density rack mounting. The amplifier shall have Thermal protection and Overload protection. The amplifier shall use highly efficient class-D switched mode technology for low power consumption. The amplifier shall have constant voltage outputs for 70 V and 100 V with 80% overall power efficiency. The loudspeaker connections shall be on a detachable screw terminal with safety insulation and shall be transformer isolated and floating with respect to ground. The amplifier shall have a ground leakage detector per channel to detect insulation failure of the loudspeaker wiring to warn against hazardous situations. The amplifier shall be protected against overheat, overload and short circuits.
- The Power Amplifiers shall have to connect an external audio source by using up to the eight BGM inputs (1 per channel) with the sensitivity level regulation. In the alarm mode the BGM inputs shall have to be muted by shorting the lines from BGM CTRL to the ground.
- The amplifier shall have an internal mounting option for a loudspeaker line and individual loudspeaker supervision system using communication to end-of-line supervision units or loudspeaker supervision units. Power supply to and communication with these supervision units shall be via the 2-conductor loudspeaker cable itself, without the need for additional conductors or shielded wiring.
- The amplifier shall have also the following parameters
- All Channels @ 66Ω 140 WRMS
- Frequency response (-1 dB, -3dB) 20Hz - 30kHz
- S+N/N 20Hz - 20kHz @ 1W/4Ω >85dB
- POWER @ 1kHz 1% THD, 100V output
- Anti-clip @ 2dBV input

- The amplifier shall be able to monitor the mains power and the battery power to the amplifier. The amplifier shall have a configurable sleep mode to save battery power in case of mains power failure, with automatic wake-up in case a priority call must be made.
- The amplifier cabinet shall be 19”-wide and 2U-high for easy rack mounting without the need for free rack space between units.

9.8.9. RECESSED CEILING SPEAKER (6W)

It shall meet the following minimum requirements:

- Rated power :6W
- Rated voltage : 100 volts
- Coverage 1500
- Effective frequency range : 115 to 17 kHz
- Power handling capacity : 6 watts
- Sound pressure level at 1 KHz, 1W, 1m : 105 dB
- Speaker diameter : 150mm
- Protection Class : IP 50

9.8.10. CD player

- CD player shall have stereo audio source including FM tuner, USB port, SD slot and Bluetooth connection.
- CD player shall have balanced and unbalanced stereo audio outputs and headphones output (stereo jack) with volume control in frontal panel.
- CD Player shall have IR remote control, FM antenna, stereo RCA cable and rack-mount bracket included.

9.8.11. PAS Cables

The PAS cables shall be as mentioned in the Bill of Quantities. The cables shall be 2.5mm2 Core LSZH insulated. The PVC conduits shall be used for the installation of PA system. Sizes of cable shall be provided as per standard length. The Paging console microphone shall be operated on Cat 6 cable.

9.9. IP BASED PABX AND TELEPHONE SYSTEM

The scope of works shall include supply, Installation, Testing & Commissioning of IP Telephone system with passive work complete with equipment, accessories, tools, labor and all associated work for 100% completion of work. All bidders shall have to visit the site to take physical dimensions of hoist way, pits overhead and machine room to verify their horizontal / vertical lengths etc. before submission of proposals. The bidders may raise the queries for any clarification, missing information or ambiguity if any, within one week after issuance of tender documents. Any work to be carried out by the owner / main contractor, should be mentioned clearly along with the bid, otherwise no claim against extra work shall be acceptable. Specification, Drawings and BOQ etc. should be read carefully to comply with specified loads, serving landings and other general and special safety features. Any deviation from specification / BOQ should be mentioned well in time before submission of bid.

The IP Based Telephone System works are to be performed; the requirements given in the Schedule shall be fulfilled. The Contractor shall be responsible and provide the following:

All the Major equipment e.g. Call Manager, Gateway, 19'' rack, IP Phone Executive, Analogue Phone, Server, all Software Licenses shall be provided from the same manufacturer.

- Provide the necessary hardware and software for above System:
- All software packages shall be provided in original installation media along with their licenses
- Preparing an Engineering Design Report covering, at least, the following subsystems:

1) Detailed Drawings for the IP Telephone system showing all areas of the project.
2) The exact quantities and types of hardware and software required
3) Cable , conduit schedules and routing plan
4) Schematics and interconnection diagrams of complete IP Telephone system showing Telephone system components including Call Manager, Gateway, 19'' rack, IP Phone Executive, Analogue Phone, Server, all Software Licenses and other elements to monitor and control the processes outlined above.
5) Technical details of the hardware and software of the complete systems.
6) Details of any civil works required.
7) Detailed description of the data acquisition software, user configurable functions and software features to be provided.
8) Complete details, brochures and pictures of the proposed area.
9) Installation, testing and commissioning procedures and methodology.

- Procure, transport and deliver equipment and hardware to site, after approval of the above report(s) by the Engineer. No payment shall be made without approval of design report.
- Submit Factory Acceptance Test procedures along with Schedule of Time
- Design, Install, test and commission of IP Telephone system in accordance with the procedures given in the engineering design report.
- Provide training to the Employer's personnel.

Bidder shall submit with his bid the following Documents/Data for all system equipment including Call Manager, Gateway, 19'' rack, IP Phone Executive, Analogue Phone, Server, all Software Licenses.

- Brochures and data sheets of each equipment
- Test standards and design
- Backup calculations
- End user certificates
- International Standards Reports/Certificates

9.9.1. GENERAL

The IP Telephone system shall be supplied and installed by approved Manufacturer to Consultant's approval. The Telephone system is intended to establish efficient communication. The Telephone system shall be suitable for making local, long distance and overseas calls.

The proposed Telephone system shall comprise the following equipment but not limited to;

- Main Distribution Frame
- Main Telephone Junction Box
- Analog Telephone Sets
- Executive Telephone sets
- All required accessories

The Contractor shall also provide any other equipment and materials, which are deemed necessary for the completion of system, without any extra cost.

9.9.2. STANDARDS

All equipment shall be of imported origin. Equipment design and manufacturing shall be only from Europe, USA and/or from the list of mentioned brands at the end of these specifications. Materials/Equipment shall be designed, manufactured, tested and installed according to the BS/IEC/ISO/ITU/EN/CE Recommendations. The latest edition and amendments shall apply in all cases. As a minimum, following shall be applied:

a. EN 60950-1:2006/A11:2009/A1:2010/A12:2011/A2:2013 Information technology equipment – Safety – Part 1: General requirements.

b. EN 55032:2015 Electromagnetic compatibility of multimedia equipment – Emission requirements.

c. BS EN 61000-3-2:2014: Electromagnetic compatibility (EMC). Limits. Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems.

d. EN 55024:2011: Information technology equipment. Immunity characteristics. Limits and methods of measurement

e. EN 61000-3-2:2014: Electromagnetic compatibility (EMC). Limits. Limits for harmonic current emissions.

9.9.3. WARRANTY

The Contractor shall provide warranty for all equipment for a period of three (03) years through authorized local distributor commencing the hand-over and acceptance date to the Employer. No equipment shall be accepted without warranty certificate from the manufacturer. It shall cover all costs for WARRANTY SERVICE, including parts replacement, labor, prompt field service, pick-up, transportation, and delivery. No extra cost shall be admissible for Warranty services.

9.9.4. IP PABX

IP PABX service shall comply with the following:

1) The IP PABX should comprised of a system of inter-operating components: i.e. Call Manager, Gateway, Switch, extension modules (TDM, GSM), emergency power supply and 19'' rack.
2) The IP PABX should be excellent communication quality and high flexibility, the system provides a foundation for building secure VoIP solutions. The IP PABX shall Supports basic calling services, including communications system with wide range of services i.e. contact center and call center, communicator, chat, SMS sending, calls recording, voice2mail, fax2mail, conferences and video conferences, manageable call queuing.

3) The IP PABX should be scaled, including redundant control, power supply and support. Quick communication between branches, packet-based data transmission and additional routes for telecommunications traffic in the event of failure shall ensure top-level customer service. Call histories shall be analyzed to identify and resolve performance bottlenecks. Quick and simple access is required to the central exchange: directly via LAN/WAN or via the Internet allows for immediate response and improves system management. System security shall ensure by means of video and voice connection encryption (TLS/SRTP), and redundancy. The doubling of system components to ensure continuous operation even during a technical failure. The IP PABX shall handle SIP phones text messages. Voice calls, as well as billing data, shall be recorded.
4) Multi-purpose voicemail system (voice to mail) and advanced IVR. The integrated management of multiple system components from a single location with the Configuration WEB tool will make life easier for any administrator.
5) The IP PABX shall Supports voice conference services and three conference joining modes: system convening, moderator convening, and individual dialing-in.
6) The IP PABX shall Supports the built-in voice mailbox service and at least Hybrid IPABX having Capacity 1000 lines Including Network Switches, Call Mangers, Gateways, Original Licenses, Power Supply for allows operation at power failure for minimum with Four hour backup,
7) Number of Subscribers
    - SIP: 100
    - FXS: 200
    - CTS: 200
    - Number of Concurrent Connection: 100
    - 19 inch Rack
    - VOIP Line: 128
    - ISDN E1 Public Line: 1.

9.9.5. Main Telephone Junction Box

Main Telephone junction shall be made with 16SWG sheet steel housing, power coated paint of approved colure consisting of specified distributer blocks/tag blocks for incoming and outgoing PTCL line from Optical Node Unit (ONU).

9.9.6. IP Executive Telephone

The executive IP telephone sets to be supplied shall comply and provide with the following:

Voice:

- HD Audio voice quality - effective sound emitter in phone base
- Codec audio G.711
- Echo cancelation system
- Speakerphone mode - full duplex
- 10 ringing tones
- 12 adjustment degrees of ringing volume

- Adjusted volume of speakerphone, handset and headset

Display and User Interface:

- High quality color, touch TFT screen, resolution 480 x 320 pixels
- 12 degree of display brightness
- Energy saving display functions
- Presentation of hour, day of week and date
- Presentation of call duration time while conversation
- Touch buttons for menu, phonebooks, contacts and services
- Clear icons, different font colors, intuitive menu
- Synchronization with server - installation and update of phone

Keyboard:

- Navigation key for direct function selection - during call it enables smooth volume adjusting.
- 19 programmable, backlight buttons.
- 38 programmable keys (2x19) - internal or external number, program PBX function, save remote controller / automation function such as door or gate opening etc.
- PoE for IP phone.
- 5 VIP touch buttons on screen - programming of 5 lines, VIP contacts or PBX services.

Main Operation Buttons:

- SPEAKER - speaker icon
- HEADSET - backlight button for headset
- CALL END - button for finishing call
- TRANSFER - button for transferring call
- REDIAL - redialing last dialed number

Backlight Function Buttons:

- MUTE - mute
- PLUS/MINUS - volume adjustment
- RING - optical ringing information

Buttons for Direct Access to Service (programmable):

- DND
- Call forwarding
- Park
- 3PTY
- Urgent call
- Headset - backlight button for switching it on
- Program of intelligent screen touch buttons

Call and Contact Functions:

- Private and public phonebook as well as extension number list - up to 10 000 of contacts, up to 20 000 numbers and 1 000 groups
- Entry with name and number
- Phonebook synchronization with PC

- Defining up to 5 lines on touch screen
- Received calls / missed calls / dialed numbers history - max 300 000 entries
- Recording calls - Embedded Recording

Realized Functions:

- 5 way Conference calls and 3 Party calls
- Call recording
- Remote work and mobile workers –
- Voice mail
- Hold / reject / resume call
- Waiting call information
- Manual call transfer
- Automatic call forwarding while busy, DND or not answer
- Lock anonymous or malicious calls (MCID)
- Service „Do not disturb”
- Music on Hold

Administration, Security and Protocols:

- Factory configuration as DHCP client
- Two access levels administrator and user
- Possibility of manual configuration for work without DHCP server
- Automatic phone firmware update from PBX
- Automatic configuration according MAC address
- Protections - Real Time Protocol (RTP)
- Encrypted signaling between server and phone
- Internet protocol: IPv4 (RFC0791)
- Domain Name System (DNS Client)

9.9.7. Analog Phone

The instrument shall be standard single line push-button type with analogue voice transmission and adjustable volume control for the receive side. The keypad and dialing from the telephone set shall conform to the latest standard. The Purchaser/Engineer shall approve the color of the telephone set. Type and make of the telephone along with technical information shall be supplied.

Telephone sets shall be supplied without CLI features. The telephone sets to be supplied shall comply with the following:

- Plug-in, coiled handset cord.
- Palladium silver contacts in the speech circuit.
- Adjustable ringing volume.
- Redial
- Flash
- Adjustable voice level.
- Service management function
- Dialing mode Pulse / Tone
- DTMF dialing system

- Last number redial function – REDIAL
- Transfer of calls function – FLASH
- Turn off the microphone during a call – MUTE
- Insert a pause between numbers dialed – PAUSE
- Ring tones – switching the ringer volume
- Signaling IN-USE
- Comfortable lightweight headset
- Mounted on a wall or desktop
- label to save your number
- Operating range – temperature from 0° C to 45° C,
- Relative humidity up to 90% RH

9.9.8. MANAGEMENT FEATURES

The system should have the below management features:

- Supports web-based service management.
- Allows users to configure voice gateways, analog access devices and IP phones on web pages.
- Supports integration with Microsoft Active Directory (AD) to synchronize directory data from the AD.
- Allows users to configure personal service, schedule conferences, and manage conference on web pages.
- Allows the administrator to add and delete users.
- Allows the administrator to select a user account and configure services for the user account.
- Allows the administrator to add, modify, and delete call barring accounts.
- Allows the administrator to import and export user accounts in batches.
- Supports department management, including adding departments and specifying department administrators.
- Multiple administrators can be specified for a department.
- Allows users to sort departments by name or directly drag departments to relocate the departments.

  The system shall be open to integrate as below
- Provides open interfaces on the server side to provide voice, video, conferencing, and instant messaging functions.
- Supports third-party authentication upon soft client logins.
- Provides open interfaces on the server side to integrate a third-party directory.
- Provides open interfaces on the Desktop client side to provide voice, video, conferencing, and instant messaging functions.
- Provides open interfaces on the mobile client side to provide voice, video, conferencing, and instant messaging functions.

9.9.9. Main Distribution Frame

The termination equipment for the trunk and extensions circuits shall be wall-mounted type. It shall be sized to accommodate all internal and external circuits plus a twenty percent

spare capacity. The connecting blocks will be of the quick-connect type. Each of the trunk circuits and outside cable pairs will be protected with over-voltage and over-current protectors. These protectors shall be either carbon or gas tube type. MDF shall have the capacity of 1x1000 Pair wiring Tag blocks.

9.9.10. Power Supply

In the equipment room, the mains supply provided by WAPDA shall be available. The mains voltage (230 Volt AC/50 Hz) will be subject to possible fluctuations and variations normally encountered in the WAPDA power supply network. The Contractor shall be solely responsible to ensure that its proposed equipment is designed to function from the WAPDA mains voltage as well as on backup power supply system. Minimum four hours backup power supply shall be provided.

9.9.11. Software Features

The system shall have following minimum features:

- Trunk direct inward dialing
- Call data recording with customized report option
- Malicious call trace
- Night service
- Dial/call by name
- Password for up/down grading of traffic class
- Number redial
- Call forwarding
- Call pickup
- System speed dialing
- Individual speed dialing
- Call back on no answer
- Call transfer
- Three and eight party conference
- Distinctive ringing
- Timed reminder service
- Hold toggle
- Connection restriction
- Cyclic/linear comfort hunt group
- Class-of-service changeover
- PIN/follow me
- Do not disturb
- Camp-on or camp-on security
- Attendant Overflow
- Call Park
- Call Transfer
- Handset/headset Operation
- Attendant Intercept
- Overriding

- Trunk Queuing
- Speed Calling

9.9.12. Telephone Cables

The Telephone cables shall be multi-pair as mentioned in the Bill of Quantities. The cables shall be PVC insulated having 0.6 mm dia. Tinned copper conductor cables. The PVC conduits/Cable tray shall be used for the installation of Telephone System. Telephone cables Sizes shall be as per standard Length. Size of cable calculation shall be provided in drawings.

9.10. VIDEO CONFERENCE SYSTEM

The scope of works shall include the design, supply, installation, testing and commissioning of a Video Conferencing system consisting of Hardware Codec, Remote, Cables and Microphone, Software ,HD Camera Dual Stream, Support – On Single Screen, Multisite Support ,Flat Screen, Multimedia Projector ,Ceiling mounting hanging bracket for Projector, Motorized Projector Screen, VGA, HDMI & RC Outlet with face plate, VGA cable and all associated accessories to make a fully operational on line Video Conferencing System with complete associated electrical and communication wiring works, control equipment, mounting brackets and accessories. Video Conferencing System shall be provided for the rooms where video conferencing is required to connect team members for more productive meetings.

The Contractor shall be responsible for providing complete turnkey system solution including auxiliary equipment for best quality of service, and all such equipment with accessories shall be deemed to be included in the scope of Contractor and no extra payment shall be made to the Contractor for these. The Contractor shall have to visit the site to take physical dimensions of the site to verify horizontal / vertical dimensions etc. before submission of proposals. The bidders may raise the queries for any clarification, missing information or ambiguity if any, within one week after issuance of tender documents. Any work to be carried out by the Contractor, should be mentioned clearly along with the bid, otherwise no claim against extra work shall be acceptable. Specification, Drawings and BOQ etc. should be read carefully to comply with specified conditions and other general and special safety features. Any deviation from specification / BOQ should be mentioned well in time before submission of bid.

Video Conference System works are to be performed as per the requirements given in the specifications. The Contractor shall be responsible and provide the following:

- Provide the necessary hardware and software for above System.
- All the Major equipment of Video Conference System shall be provided from the same manufacturer.
- All software packages shall be provided in original installation media along with their licenses
- Preparing an Engineering Design Report covering, at least, the following subsystems:

1) Detailed Drawings for the Video Conference System

2) Schematics and interconnection diagrams showing Video Conference System components.

3) The exact quantities and types of hardware and software required

4) Technical details of the hardware and software of the complete systems

5) Cable, conduit schedules and routing plans.

6) Details of any civil works required.

7) Detailed description of the software, user configurable functions and software features to be provided.

8) Installation, testing and commissioning procedures and methodology.

- Procure, transport and deliver equipment and hardware to site, after approval of the above report(s) by the Engineer. No payment shall be made without approval of equipment.
- Design, Install, test and commission of Video Conference System in accordance with the procedures given in the engineering design report. No payment shall be made without approval of design report.
- Provide training to the Employer's personnel.

Bidder shall submit with his bid the following Documents/Data for all system equipment including control equipment, Hardware Codec, Remote, Cables and Microphone, Software, HD Camera Dual Stream, Support – On Single Screen, Multisite Support, Flat Screen, Multimedia Projector, Ceiling mounting hanging bracket for Projector, Motorized Projector Screen, VGA, HDMI & RC Outlet with face plate, VGA cable and all associated accessories.

- Brochures and data sheets of each equipment
- Block diagram of the system showing interconnectivity
- Bill of Quantities (BOQs) as per specified format
- Cost breakup of each equipment
- Detail of Cabinets
- Test standards and design
- Backup calculations showing that Hard Disks shall be able to record data of users for a period of one Month.
- End user certificates
- International Standards Reports/Certificates

9.10.1. STANDARDS

All equipment shall be of imported origin. Equipment design and manufacturing shall be only from Europe, USA and/or from the list of mentioned brands at the end of these specifications. Materials/Equipment shall be designed, manufactured, tested and installed according to the BS/IEC/ISO/ITU/EN/CE Recommendations. The latest edition and amendments shall apply in all cases.

9.10.2. WARRANTY

The Contractor shall provide warranty for all equipment for a period of three (03) years through authorized local distributor commencing the hand-over and acceptance date to the Employer. No equipment shall be accepted without warranty certificate from the manufacturer. It shall cover all costs for WARRANTY SERVICE, including parts

replacement, labor, prompt field service, pick-up, transportation, and delivery. No extra cost shall be admissible for Warranty services.

9.10.3. FUNCTIONAL DESCRIPTION

The system components shall be of modular design to allow ease of installation, service, future expansion, up-grades and additions to the system. The equipment shall have operating environments to allow complete functionality at a temperature range of 0 degree to 40 degree centigrade and a relative humidity of 90%.

9.10.4. VIDEO PERFORMANCE FEATURES

The system must have the following video performance features:

Communications

- H.323 and SIP standards, SIP TLS
- 4Mbps
- RJ45 network LAN (10/100/1000)
- Manual bandwidth settings
- Content sharing capability from all sites

Video

- Pan/Tilt/Zoom Camera
- 2-megapixel CMOS sensor
- 16x optical zoom; ±100° pan; ±25° tilt
- FOV 61° (H); 35° (V); 67° (Diagonal)
- All resolutions at 30fps
- HD1080p (1920 x 1080) RTMP support for video streaming
- Network:
- 10/100/1000 Mbps; NAT / firewall traversal; High Efficiency Lost

Packet Recovery , API support via Telnet; Wake-on LAN (WOL) support; IPv4 and IPv6 support; Network Test and QoS

Security:

AES (Advanced Encryption Standard) function (128-bit)

Video standards:

H.264, H.264 HP, H.264 SVC, H.263+, H.263, H.261

Video inputs:

HD camera, VGA, DVI (HDMI)

Audio standards:

G.711, G.722, G.722.1, G.728, G.722.1C

Audio features:

Automatic gain control (AGC) Advanced noise reduction Acoustic echo cancellation (AEC)

Web management tool:

Remote management; Live monitoring; Firmware update; Phonebook download / upload / edit; Restore system setting

Mobility Software:

Supported devices: Windows® and Mac OS®, iOS, Android phones and tablets, Windows 8 tablets

PTZ camera shall be provided with video conference system and shall be complete in all respect.

9.10.5. RECESSED CEILING SPEAKER (6W)

It shall meet the following minimum requirements:

- Rated power :6W
- Rated voltage : 100 volts
- Coverage 1500
- Effective frequency range : 115 to 17 kHz
- Power handling capacity : 6 watts
- Sound pressure level at 1 KHz, 1W, 1m : 105 dB
- Speaker diameter : 150mm
- Protection Class : IP 50

9.10.6. MIXER AMPLIFIERS (120W)

- The Mixer Amplifiers EN Standard and shall have a network interface. The network interface of the amplifiers shall support digital audio and control signals.

9.10.7. INTEGRATOR COLLABORATE

- Integrator has the following components:
- Hardware Codec, Remote, Cables and Microphone 02
- Software with IP Support
- HD Camera
- Flat Screen
- Multimedia Project
- speakers

9.10.8. FLAT SCREEN

Flat Screen (65” Full HD LED display) shall be installed in all required rooms mention in drawings with all connecting cords and mounting stands.

9.10.9. MULTIMEDIA PROJECTOR

Multimedia Projector suitable for education environments, having power full large format display, rounding out full line of IT visual display on projector screen, Auto focus & zoom lens, high performance in color and brightness up to 3000-3500 lumens with low operational noise, sound from any AV or PC source, built-in speaker, standardized audio/video connection and HDMI port, suitable for ceiling mounting facility, operating voltage 220V AC 50Hz, compact design, complete in all respects.

9.10.10. MOTORIZED PROJECTOR SCREEN

otorized Projector Screen shall be provided suitable for education environments.

9.10.11. CEILING MOUNTING HANGING BRACKETS

Ceiling mounting hanging bracket for Projector, consisting with sheet steel or galvanized channel having adjustable arrangement up and down.

9.10.12. VGA, HDMI & RC OUTLET

The VGA, HDMI & RC Outlet with face plate shall be installed in standard switch back box. Other I/O Ports which may be required are:

- 1x 9 Pin DSUS (for connecting camera)
- 1x Mini DIN, S. video, auxiliary/ document camera
- 2x RCA
- 1x DVI
- 1x MiniDin, S-video(for main monitor)
- 2x RCA
- 1x DVI
- XGA Output

9.10.13. VGA & HDMI CABLE

VGA & HDMI cable in 25/50mm dia. PVC conduits from Connector Box to Multimedia Projector. Complete with Termination at both ends. Cable shall be double shielded having 3 analog and 8 signal cables.

All cabling is to be concealed in to the structure of the building, using conduits having minimum dia. unless otherwise specified or to be fixed in a cable tray or cable management system (if and only if, it is specified) only using metal ties no other fixing is acceptable.

9.11. COMPUTER NETWORKING AND WI-FI SYSTEM

The scope of works shall include the design, supply, installation, testing and commissioning of Network and Wi-Fi System complete with associated electrical and communication wiring works, control equipment, Access Switches, Core Switches, Wi-Fi WLAN Controllers, Wi-Fi WLAN Access Points, mounting brackets and accessories. The Contractor shall be responsible for providing complete turnkey system solution including auxiliary equipment for best quality of service, and all such equipment with accessories shall be deemed to be included in the scope of Contractor and no extra payment shall be made to the Contractor for these. The Contractor shall have to visit the site to take physical dimensions of the site to verify horizontal / vertical dimensions etc. before submission of proposals. The bidders may raise the queries for any clarification, missing information or ambiguity if any, within one week after issuance of tender documents. Any work to be carried out by the Contractor, should be mentioned clearly along with the bid, otherwise no claim against extra work shall be acceptable. Specification, Drawings and BOQ etc. should be read carefully to comply with specified conditions and other general and special safety features. Any deviation from specification / BOQ should be mentioned well in time before submission of bid.

The Network and Wi-Fi System works are to be performed as per the requirements given in the specifications. The Contractor shall be responsible and provide the following:

- Provide the necessary hardware and software for above System.
- All the Major equipment e.g. Control Equipment, Access Switches, Core Switches, Wi-Fi WLAN Controllers, Wi-Fi WLAN Access Points and Storage backup devices shall be provided from the same manufacturer.

- All software packages shall be provided in original installation media along with their licenses.
- Preparing an Engineering Design Report covering, at least, the following subsystems:
  1) Detailed Drawings for the Network and Wi-Fi System showing all Coverage areas.
  2) Schematics and interconnection diagrams showing Network and Wi-Fi System components.
  3) The exact quantities and types of hardware and software required
  4) Technical details of the hardware and software of the complete systems
  5) Cable, conduit schedules and routing plans.
  6) Details of any civil works required.
  7) Detailed description of the software, user configurable functions and software features to be provided.
  8) Complete details, brochures and pictures of the proposed area.
  9) Installation, testing and commissioning procedures and methodology.
- Procure, transport and deliver equipment and hardware to site, after approval of the above report(s) by the Engineer. No payment shall be made without approval of equipment.
- Design, Install, test and commission of Network and Wi-Fi System in accordance with the procedures given in the engineering design report. No payment shall be made without approval of design report.
- Submit Factory Acceptance Test procedures along with Schedule of Time
- Provide training to the Employer's personnel.
- Bidder shall submit with his bid the following Documents/Data for all system equipment including control equipment, Access Switches, Core Switches, Wi-Fi WLAN Controllers and Wi-Fi WLAN Access Points.
- Brochures and data sheets of each equipment
- Block diagram of the system showing interconnectivity
- Bill of Quantities (BOQs) as per specified format
- Cost breakup of each equipment
- Detail of Cabinets
- Coverage area of each equipment
- Test standards and design
- Backup calculations showing that Hard Disks shall be able to record data of users for a period of two Months.
- End user certificates
- International Standards Reports/Certificates

9.11.1. STANDARDS

All equipment shall be of imported origin. Equipment design and manufacturing shall be only from Europe, USA and/or from the list of mentioned brands at the end of these

specifications. Materials/Equipment shall be designed, manufactured, tested and installed according to the BS/IEC/ISO/ITU/EN/CE Recommendations. The latest edition and amendments shall apply in all cases.

9.11.2. REQUIREMENTS

The Network solution shall be supplied and installed by Manufacturer approved by the Consultant.

The work will be carried out concurrently with the works of the building. The contractor shall provide all materials and equipment: perform all the works necessary for the execution and completion including testing and commissioning of Data Network installation works, specified herein and to the satisfaction of the Consultant.

9.11.3. WARRANTY

The Contractor shall provide warranty for all equipment for a period of three (03) years through authorized local distributor commencing the hand-over and acceptance date to the Employer. No equipment shall be accepted without warranty certificate from the manufacturer. It shall cover all costs for WARRANTY SERVICE, including parts replacement, labor, prompt field service, pick-up, transportation, and delivery. No extra cost shall be admissible for Warranty services.

9.11.4. ACCESS SWITCH LAYER-3

The Access Switches to be Supplied Shall Comply with the following:

- 24 x Ethernet 10/100/1000 Base-T ports, POE/POE+ Points, 4 x 1Gig SFP ports
- Switching capacity at-least 200 Gbps or higher and forwarding throughput of 40 Mbps or higher
- Switch should support stacking up to 8 switches
- Must support line rate forwarding on all ports
- Jumbo frames: 9Kbytes
- The equipment must support more than 16K MAC address tables
- Should support Ethernet Ring Protection Switching
- Support Mac-based, Port-based, protocol-based, and IP subnet-based VLAN assignment, up to 4K active VLAN, Guest VLAN or equivalent, voice VLAN or equivalent
- The equipment shall provide Static route.
- The equipment must support IGMP snooping v1/v2/v3, MLD snooping v1/v2, multicast VLAN replication
- The equipment must support ingress and egress traffic shaping and VLAN based traffic limit, flow mirroring
- The equipment must support bidirectional ACL,DHCP snooping, port-based ACL, VLAN-based ACL, automatic isolation of attack sources, CPU defense, IP Source Guard, port-based network access control according to IEEE 802.1x standard
- The equipment must support SNMPv1/v2c/v3, Telnet, CLI, web management and automatic configuration

- Console cable, Power Cable, Rack-mount kit.
- POE Power :350W

9.11.5. CORE SWITCH

The core switch to be supplied Shall Comply with the Following:

- 24 x 100/1000 Base x SFP Ports,4x combo 100/1000 Base-x SFP ports and 4x 10G SFP + port with 1G single mode SFP
- ASIC ready platform.
- Switching capacity at-least 500Gbps or higher and forwarding throughput of 132 Mbps or higher
- Switch should support stacking multiple switches in a stack.
- Dual Power Supply
- Must support line rate forwarding on all ports
- Jumbo frames: 9Kbytes
- The equipment must support more than 32K or higher MAC address tables
- Support Mac-based, Port-based, protocol-based, and IP subnet-based VLAN assignment, up to 4K active VLAN, Guest VLAN or equivalent, voice VLAN or equivalent
- The equipment must provide Static route, RIP, OSPF, OSPFv3,
- Should support redundancy protocols like VRRP and VRRP6 entries.
- The equipment must support IGMP snooping v1/v2/v3, snooping v1/v2, multicast VLAN replication, PIM DM, PIM SM, PIM SSM
- Switch must support ingress and egress traffic shaping and VLAN based traffic limit, flow mirroring
- Rate limiting on packets per port, 8 queues per port, interface-based traffic policing, 802.1p, DSCP
- priority, WRR, DRR, SP, WRR+SP, DRR+SP
- The equipment must support bidirectional ACL, port-based ACL, VLAN-based ACL, automatic isolation of attack sources, CPU, DHCP Snooping, IP Source Guard, port-based network access control according to IEEE 802.1x standard
- The equipment must support SNMPv1/v2c/v3, Telnet, RMON, SSHv2, CLI, web management and automatic configuration

9.11.6. DISTRIBUTION SWITCH

Features of 8 port POE access switch shall be as follows:

Fixed configuration architecture, Minimum 2 slots available for future use, Support for hot swappable expansion modules, Switching capacity: 100 Gbps or higher, Forwarding Speed: 40 Mpps or higher, 24-Port Small Form factor Pluggable (SFP) based module for Gigabit Ethernet over fiber optics, no over subscription, 4 Ports for 10 Gbps connectivity over fiber optics, Future support to provide at least 2 ports for 10 Gbps, Redundant supervisory engine, Multilayer Quality of Service (QoS), Web based management interface.

9.11.7. Eight (08) Port POE ACCESS SWITCH

Features of 8 port POE access switch shall be as follows:

- 8/16/24*10/100/1000M* RJ45,2*SFP
- comprehensive security protection system to ensure long-term stable operation of the network
- rich QoS strategy and ACL access control function, multi service, efficient integration operation
- Port convergence and spanning tree protocol improve the ability of link redundancy backup
- Provide secure, flexible ways of providing Web, network management, CLI command line, SNMP, etc.
- provide network diagnosis, cable inspection, system logs and other functions, simple maintenance

9.11.8. FACE PLATE

Simplex face plate shall have CAT-6 RJ-11 and RJ-45 I/O for voice and data point white/off white finish, complete with shuttered click-in, labels and all accessories including metal steel back box, recessed on wall or column.

9.11.9. WI-FI WLAN CONTROLLER

The Wi-Fi WLAN Controller to be supplied shall comply with the Following:

- Support IETF 5415 CAPWAP protocol
- Support 802.11a, 802.11b, 802.11g, 802.11n, 802.11e, 802.11d, 802.11ac Wave 1 and Wave 2, 802.11ax. Support transmit rate selection and channel selection
- Fiber Uplink Port
- Number of managed APs per controller ≥ 250
- Packet forwarding capacity ≥ 4Gbps
- Support authentication based on MAC, 802.1x (EAP-PAP, EAP-MD5, EAP-PEAP, EAP-TLS, EAP-TTLS Portal MAC +Portal
- Support built-in portal server and can support user number more than 1k
- Support both centralized forwarding and local forwarding
- Support automatic or manual channel and power adjustment
- Support load balancing based on traffic and user
- Rouge device scan, identification, defense, and countermeasures, which includes dynamic blacklist configuration and detection of rogue APs, STAs, and network attacks.
- Support GUI-based web system management: and the web system supports local GUI-based configurations
- Rack mount Kit Included.

9.11.10. WI-FI WLAN ACCESS POINT

The Wi-Fi WLAN access point to be supplied shall comply with the Following:

- Fully comply IEEE802.11a/b/g/n/ac wave 2 standard, support working in both 2.4G and 5G, data rate min 1.5Gbps, and support 4x4MIMO (3SU-3MU) with 4 spatial streams
- AP License to work with Controller
- DHCP snooping, Dynamic ARP Inspection (DAI), IP source guard (IPSG), support STBC, LDPC, MLD and MRC.
- Min. Antenna Gain: Min 3dBi on 2.4GHz and 5dBi on 5GHz
- Should provide 22 dBm power on 2.4 and 23dBm on 5GHz and power increment should be min 3dB.
- Should be able to work in controller based and standalone mode.
- 1 x 10/100/1000M self-adaptive Ethernet interface (RJ45), PoE
- 1 x Management console port (RJ45)
- Must support at least 50 users per antenna
- WPA2/AES, TKIP, Rogue Detection, MAC Authentication, EAP-FAST, EAP-TLS, EAP-TTLS, PEAP v0 & v1, EAP-SIM
- 802.1x authentication, MAC address authentication, and Portal authentication

9.11.11. FIREWALL

The Firewall to be supplied shall comply with the Following:

- Firewall should have RISC based CPU and support UTM features including firewall, IPS, antivirus, anti-spam, Proxy based web filtering and content filtering services with three-year subscription license.
- 12 x GE (RJ-45) and 2 x GE Combo Ports with 1 x 1G Single Mode SFP.
- Firewall performance: 7 Gbps or higher.
- IPS throughput: 450 Mbps or higher.
- IPSec VPN throughput: 3 Gbps or higher.
- Number of concurrent sessions: 1.5 Million or higher.
- 400GB or higher SSD.
- Authentication methods (LDAP, RADIUS, TACACS+, 802.1x, PKI and Certificates, POP3/POP3S)
- Virus Outbreak Protection as an additional layer of proactive protection targeted at new malware; comparing and detecting threats using a real-time database.
- Defense against DDoS attacks, such as the SYN flood and UDP flood attacks
- VPN technologies: IPSec VPN, SSL VPN, L2TP VPN, MPLS VPN, and GRE
- IPv4: static routing, RIP, OSPF, BGP, and IS-IS
- IPv6: RIPng, OSPFv3, BGP4+, IPv6 IS-IS.
- Transparent, routing, or hybrid working mode and high availability (HA), including the Active/Active and Active/Standby mode

9.12. BIOMETRIC ATTENDANCE SYSTEM AND VISITOR MANAGEMENT SYSTEM WITH INTEGRATED WEB BASEDTIME MANAGEMENT

The scope of works shall include the design, supply, installation, testing and commissioning of Web Based Time Management Biometric RFID machines with Integration of Web Based Visitors Management System complete with associated software's, the supplier shall be responsible for providing best quality of service, and all such equipment with accessories shall be deemed to be included in the scope of Contractor and no extra payment shall be made to the Contractor for these. The system shall include Hardware and Software of TMS, complete operating system. The contractor shall have to visit the site etc. before submission of proposals. The bidders may raise the queries for any clarification, missing information or ambiguity if any, within one week after issuance of tender documents. Any work to be carried out by the owner / main contractor, should be mentioned clearly along with the bid, otherwise no claim against extra work shall be acceptable. Specification, Drawings and BOQ etc. should be read carefully to comply with specified loads, serving landings and other general and special safety features. Any deviation from specification / BOQ should be mentioned well in time before submission of bid.

The Hardware and Software of works are to be performed; the requirements given in the Technical Specification shall be fulfilled. The Contractor shall be responsible and provide the following:

- Hardware and Software of Time Management System
- All the Major equipment e.g. Hardware and Software of Time Management System shall be provided with integration.
- Provide the necessary hardware and software for above System:
- All software packages shall be provided in original installation media along with their licenses
    1) Detailed Drawings for the Time Management System
    2) Schematics and interconnection diagrams showing Time Management System.
    3) The exact quantities and types of hardware and software required
    4) Technical details of the hardware and software of the complete systems
    5) Cable, conduit schedules and routing plan.
    6) Details of any civil works required.
    7) Detailed description of the data acquisition software, user configurable functions and software features to be provided.
    8) Complete details, brochures and pictures of the proposed area.
    9) Installation, testing and commissioning procedures and methodology.
- Procure, transport and deliver equipment and hardware to site, after approval of the above report(s) by the Engineer.
- Design, Install, test and commission of Hardware and Software of TMS in accordance with the procedures given in the engineering design report. No payment shall be made without approval of design report.
- Submit Factory Acceptance Test procedures along with Schedule of Time
- Provide training to the Employer's personnel.

Bidder shall submit with his bid the following Documents/Data for all system equipment including Hardware and Software of TMS.

- Brochures and data sheets of each equipment

- Complete technical literature
- Reports

9.12.1. STANDARDS

All equipment shall be of imported origin. Equipment design and manufacturing shall be only from Europe, USA and/or from the list of mentioned brands at the end of these specifications. Materials/Equipment shall be designed, manufactured, tested and installed according to the BS/IEC/ISO/ITU/EN/CE Recommendations. The latest edition and amendments shall apply in all cases.

9.12.2. WARRANTY

The Contractor shall provide warranty for all equipment for a period of three (03) years through authorized local distributor commencing the hand-over and acceptance date to the Employer. No equipment shall be accepted without warranty certificate from the manufacturer. It shall cover all costs for WARRANTY SERVICE, including parts replacement, labor, prompt field service, pick-up, transportation, and delivery. No extra cost shall be admissible for Warranty services.

9.12.3. TIME ATTENDANCE AND ACCESS COTNROL TERMINAL

Features of time attendance and access control terminal shall be as follows:

- Finger print based time attendance and access control terminal
- 5000 user capacity
- Builtin MIFARE Proximity reader
- Ingress protection: IP65
- TCP/IP, WIEGAND RS485
- Finger print optical sensor

9.12.4. VISITOR MANAGEMENT SYSTEM (VMS)

VMS should be highly advanced that aims at enhancing corporate security. The main purpose of VMS is to track visitors entering or leaving a facility and maintain a complete history of their visits. It allows you to keep a log of all visitors to your facility; capture snaps and business card images; print customized visitor badges, token, receipts etc.; manage contractors; access a full range of visitor traffic reports and several other features. Scanning barcodes, NIC Cards and taking OCR input from Business Cards streamlines the data entry process, offering a whole new level of automation.

It should be a web-based solution integrated with Time Management System that utilizes TMS infrastructure for direct employee information.

Purpose of VMS is to improve site security with visible identification of all visitors, allows fast, effective handling of visitors.

Web-based application can be utilized over multiple sites and divisions, stores visitor and staff data to improve efficiency, saves time and resource.

REQUIRED VMS REPORTS

Type		Description
Panic Report	-	*Visitors currently inside the facility*

Visitor Traffic - Roaming Traffic
Visitor Out - Visitors who left the premises
Visit History -
Contractor In -
Contractor Out -
Contractor Visit History -
Incoming Packages -
Outgoing Packages -
Packages lying on Reception -
Visitor per Employee -
Appointment List -
Employee List - Active/Inactive
Appointments Pending -
Appointments Due -
Black-Listed Visitors -
Reception Details -

VMS FEATURES

Features	Description
Maintenance	The Visitor Maintenance Module is used to add a new visitor, edit existing visitor details and search for a visitor. The Visitor In/Out module is used to Check In and Check Out a visitor, specify the purpose of his visit and who he is supposed to meet.
Contractor In/Out/Maintenance	The Contractor Maintenance Module is used to add a new Contractor, edit existing contractor details and search for a contractor. The Contractor In/Out module is used to Check In and Check Out a Contractor, specify his services and who is assigned to supervise him
Package In/Out/Maintenance	The Package Maintenance Module is used to track all packages, parcels and folders that come in or leave the premises.
Employee Maintenance	The Employee Maintenance Module is used to maintain an employee database so that whenever a visitor comes in to visit a particular staff member, the host record is always present.
Reports	Reports include Visitor Info, Visit History, Visitors Currently In, Visits to Employee etc.
ver Module	Server Module, used to communicate with host PCs, is responsible for sending remote notifications with visitor photos to hosts/employees and receiving acceptance or rejections. The host/employee IP Address must be supplied in the host/employee database and there must be a local area network which the application will utilize.
Client Module	Client Module deployed on the host PC has an MSN like interface and very user friendly to use. It receives visitor notifications from the server, with the ability to send acceptance and rejections with custom messages.

Features	Description
Email Component	The Email component is used to send host/employee an email alert on their native SMTP email accounts, provided their email address is available in the host/employee database
Appointment Maintenance	The Appointment Maintenance Module is used to create and edit employee appointments and visit re-registrations.
Multiple Reception Counters	Support for Concurrent Reception Counters

9.12.5. HARDWARECOMPONENTS OF VISITOR MANAGEMENT SYSTEM

Webcam Component	standard FHD web camera. The Webcam Component is used to capture visitor photos for identification and security reasons.
Receipt Printing Component	The Receipt printing module makes use of a thermal printer to print receipts/tokens with a bar-coded visitor id alongside visitor name, NIC, check-in time, who is he visiting, the purpose of visit and space for host signature. When the visitor returns the barcode, id is scanned and the visitor is automatically checked out.
NIC Component	2D Barcode Scanner. The NIC Component allows the user to scan a visitor's CNIC (NADRA) with a 2d-barcode scanner and decode the barcode to extract relevant information in Urdu. The information includes NIC#, Name and Address.
Fingerprint Capture Component	Fingerprint Scanner. The Fingerprint Component requires a visitor to have his fingerprint registered, then on subsequent visits there would be no need for enter visitor information repeatedly. Scanning his fingerprint will retrieve his full record. This module can also be used as Proof of Visit. (1:N Identification for <=3000 users)

9.12.6. WEB-BASED TIME MMMANAGEMENT SOFTWARE

Web-based time attendance management software should organization, plan, monitor and transform basic employee data into information that can revolutionize workforce management.

Should be supportive diversified data collection mechanisms such as proximity, finger print, face recognition and IRIS recognition.

Support business Hierarchies, Powerful, yet easy to use and should be capable for shift management.

Web-based software must have:

- Graphical Attendance View

- Multi-User Environment
- Secure MS SQL Server Database
- Support Unlimited Employees
- Create Unlimited Fully Customized Shifts
- Explicit User Rights Management
- User Friendly Interface
- Export Data in PDF, XLS and DOC Formats
- Easy web Report for Time Sheet
- Graphical Reports

Feature of web-based attendance software

Feature	Required
Employee Count	5000
Max ESS Login Users at a time	250
Administrative Users	20 (Admin User)
Employee self-service users	1000
Shift Count	500
Scheme Count	500
Leave Count	500
Over Time Authorization	Yes
Sandwich Policy	Yes
Penalty Policy	Yes
Online Leave Approval	Yes
Online Late/Early Approval	Yes
Online Manual Entry Approval	Yes
Data Reposting	Yes
Multi Shift	Yes
Dash board with statistic graphical display	Yes
Audit trail reporting	Yes
Access Control Functionality	Yes
Graphical section at the end of each report	Yes

MIS - Reports of web-based attendance software

Worked Hours Summary	Yes
Leave Chart	Yes
Time Sheet	Yes
Average Arrival Departure Summary	Yes
Over Time Register	Yes

Periodical Consolidated Report	Yes
Periodical Over Time Register	Yes
Attendance Register Under Section 41	Yes
Attendance Register (By Time of Worked Hours)	Yes
Employee Performance	Yes
Employee Strength Report	Yes
Leave Status Report	Yes
Attendance Sheet	Yes
Time Sheet Summary	Yes
Over Time Detail	Yes
Individual Employee Consolidated	Yes
Current/Previous Attendance	Yes
Individual Leave Card	Yes

Daily - Reports of Web based attendance Software

Daily Time In	Yes
Daily Late Arrival	Yes
Daily Absentees	Yes
Daily On Leave	Yes
Early Departure	Yes
Daily Break	Yes
Daily Over Time	Yes
Daily Worked Hour	Yes
Daily Attendance	Yes
Daily Off Day	Yes
Daily Time Out	Yes

Check List - Reports of web-based attendance software

Irregular Reports	Yes
Not Swipe Out	Yes
Monthly Shift Roster	Yes
Weekly Shift Roster	Yes
Employee List	Yes
Gazetted Holiday	Yes
Master Roster List	Yes
Roster Not Created List	Yes

Parameter Listing	Yes
Management Code List	Yes
User List	Yes
Employee Detail	Yes
Shift Timing List	Yes

Personal - Reports of web-based attendance software

Time In	Yes
Late Arrival	Yes
Absentees	Yes
On Leave	Yes
Early Departure	Yes
Breaks	Yes
Over Time	Yes
Worked Hour	Yes
Attendance	Yes
Time Out	Yes
Off Day	Yes

Graphical - Reports of web-based attendance software

Top N – Absentees	Yes
Top N – Late	Yes
Top N - On Time	Yes
Top N - On Leave	Yes
Top N - Early Departure	Yes
Top N Parameter - Absentees	Yes
Top N Parameter – Late	Yes
Top N Parameter - On Time	Yes
Top N Parameter - Early Departure	Yes

9.12.7. BIOMETRIC FINGER PRINT AND RFID MACHINE

Specifications

CPU	:	1.0GHz
Memory	:	128MB RAM + 8GB Flash
Fingerprint Sensor	:	Optical
Template Capacity	:	1,000,000 (1:1), 40,000 (1:N)

Max User	:	5000,000 (1:1), 20,000 (1:N)
Capacity	:	3000 users or more
Ingress Protection:		IP65
PoE	:	Yes
Interfaces:TCP/IP.	:	Wiegand, RS485, TTLI/O, Wi-Fi, Relay
Tamper	:	Yes
Sound	:	16-bit Hi-Fi
Operating Temp	:	-20° to 50° C
Operating Voltage	:	12VDC
Certifications	:	CE, FCC, KC, RoHS
RF Card Option	:	125 kHz Em

Machine middleware should have following features:

1) Middleware should be web-based
2) Email Alert on Web Based Application.
3) Mobile App for User management, door control and Alert monitor.
4) Server Matching.
5) Device Server Mode.
6) Fingerprint Enrollment at any location through Mobile App via BIOMINI over Cloud.
7) SSL and TLS Communication Between Devices and Servers
8) Support up to 1000 devices without any performance issues.
9) Manage up to 100 concurrent client sessions of BIOSTAR 2.
10) Automatic User Synchronization from Device to Server and other Devices and from server to all devices in real time.

9.13. VIDEO WALL AND INTEGRATED SOFTWARE

9.13.1. VIDEO WALL

SMD Screens of 5x10 square meter shall be installed in TCC with Video Wall Solution of 1 Slim SMD Screens for Video Wall including all Controllers, Matrix, PCs, Graphic Cards complete in all respect and accessories.

1. Pixel pitch, mm: 2.68
2. Aspect ratio: 0.5
3. Display size, mm: 386.4 x 386.4 x 85 or equal
4. Pixel density, pixel/m²: 139,230
5. Minimum viewing distance, m: 2.5
6. Module resolution, pixel: 144 x 144
7. Number of LEDs in pixel: 1 (RGB: 3 in 1)
8. LED type and supplier: SMD, 1515, Nation star
9. Color processing, bit: 16
10. Colors up to: 281 trillion (48 bit)
11. Viewing angle horizontal / vertical: 150° / 150°
12. Maximum brightness, NIT: 1,500 - 1,850
13. Maximum calibrated brightness, NIT: 1,200 - 1,500
14. Refresh rate, Hz: 7,680
15. Scan: 1/12

16. Lifetime: > 100,000 hours (> 11.5 years 24/7)
17. Operating temperature: from +1 °C to +40 °C, 80% humidity
18. Power supply (single phase voltage):110 - 253 V; 50 - 60 Hz
19. Power supply (three phase voltage): 400 V +10% / -20%; 50 - 60 Hz
20. Power consumption, W/m²: average 300 – maximum 900

9.13.2. VIDEO CONTROLLER

1) The Video Wall Controller shall be designed and configured to manage the Control Room Operations as per the number of users and the video tiles connected to the main controller. The controller shall be Scalable for future expansion. Controller shall have IP Based controlling feature so that the user can program the setting of the video wall through the Network. The video wall controller along with video wall shall be connected to the UPS.
2) The Controller shall have high-resolution supports of 4K resolution Maximum resolution 4096 x 2970 12.1 Mpx, which shall allows o broadcast high-quality image on the display.
3) The Controller shall have built in video controllers and switches with powerful LED interface processor, audio/video matrix and an LED video control system in a single product.
4) The Controller shall have perfect picture in real time which shall adjust the color temperature and select the appropriate brightness level depending on operating conditions.
5) The Controller shall provide well-coordinated work of up to 32 LED displays.
6) The Controller shall work on remote control mode with maximum allowable distance from the LED display to the video control system shall be 10 km away. Management shall carried out through the WEB-interface

7) The Controller shall have two-level brightness calibration system Uniformity² get illumination uniformity across the entire display surface at a level above 99%.
8) The Controller shall have Built-in computer
9) The Controller shall have Maximum number of output 4

9.13.3. CALL CENTER AND EVENT ALARM SYSTEM

Standard call center with 15 seats and one Primary Rate Interface (PRI) shall be provided. It shall run on a Voice over internet protocol (VOIP) exchange with call recording features and shall be integrated to ticket management system.

The solution shall have an event based alarm system with rule-based software, where rules may be added dynamically at run time. An alarm shall be sent to any device such as a cell phone, vehicle dashboard or any computer terminal or to other stakeholder within GoB whenever some event would be triggered. System shall also be capable of sending the concerned video to the target device.

9.13.4. VIDEO MANAGEMENT SOFTWARE WITH CENTRALIZED ANALYTICS

The purpose of the Video Analytics Software shall be to analyze the video/image data captured from various sources including Cameras and get meaningful and actionable information from this data without much human aid. There shall be two basic objectives of this software system in QSCP:

1. Real Time Monitoring: Monitor live footage of Sukkur – Hyderabad Ring Road 24/7 and give users real time alerts as per predefined conditions for proactive response
2. Off Line Monitoring (Forensic Search): Advance multi-camera search capability and analysis in pre-recorded footages such as finding specific event, face or vehicle license plate, etc. for investigations

The software shall have tried and tested features/functions for city wide coverage and display on video wall. There shall be minimum lag and latency in the Video Management Software and associated network. This software shall have the following features:

- Motion Detection with objects classification (Movement of Vehicle or Human)
- Human Behavior Analysis (Running, walking, standstill, screaming)
- Face Recognition
- Smoke and Fire Detection
- Track an Object
- License Plate Search/Recognition
- Multi-Loitering
- Abandoned Objects
- Fallen Human Body
- Head Counts (People and Object Counting)
- Wrong Parking Detection
- Wrong Way Detection
- Perimeter Analysis

The software system shall also cover the offline analytics i.e. analysis based on footages which are from outside the system such as footages provided by some hotel management or cinema, etc. The system shall be capable to provide the analysis on these off line videos as well. The system shall incorporate the feature of video synopsis where the system extracts target information from video feeds and create a short video summary. System shall have minimum false alarms and compatibility with mobile phones i.e. Android. The software shall provide the option of User Management for roles, rights and privileges.

Middleware Suite shall also be deployed which shall facilitate to establish the digital business platform for the Enterprise and the Cloud. It shall enable Rawalpindi Ring Road (RRR) Organization to create and run agile and intelligent business applications while maximizing IT efficiency through full utilization of modern hardware and software architectures.

9.14. WALK THROUGH GATE SYSTEM

Walk through Gate shall be of imported origin and shall be state of the art minimally having the following features:

- At least 33 Zone Pin Point Walk Through Gate
- Built-in Power Supply
- Full Graphic Display
- IR Counter
- Multi-tier user authorizations to protect the settings
- Left Side + Right Side Detection

- Wait and Proceed Symbols
- Factory Default Presets
- Superior target detection with unmatched discrimination of harmless items such as Coins, Jewelry, Keys, and Cigarette packs etc.
- Preset programs to cover the most complete range of security applications including the new Enhanced Metal Detector (EMD)
- Superior detection and location of guns, knives and other flat and rod-shaped weapons regardless of orientation
- Circuitry with advanced Digital Signal Processor (DSP) technology locates even small, hard-to-find, floor level weapons.
- Individual zone boost adjustments allow for customization of detection characteristics and/or compensation for metallic environmental challenges.
- IP55 rating
- IEC Standard
- weather-proof
- Operating temperature range: -20º C to 60º C
- Humidity to 95% non-condensing
- Storage temperature range: -40º C to 70º C
- Alarm Indicators/Random Alarm Feature (33 zones, volume-adjustable audible tone, and bright LED visual and remote alarms).

9.15. ACCESS CONTROL SYSTEM (ACS)

The scope of work shall include the design, supply, installation, testing and commissioning of an Access Control System (ACS) and Intruder Detection System (IDS) for **Traffic Control Centre and Toll Collection Booths.** The system includes Controller, proximity Card Reader, Access Card, Electromagnetic Locks, Engineer/Operator workstation, Push Buttons, Cabinet and Enclosures, emergency door release break glass button and Intrusion/Curtain Detectors and all associated accessories to make a fully operational with complete associated electrical and communication wiring works, control equipment, mounting brackets and accessories.

The Contractor shall be responsible for providing complete turnkey system solution including auxiliary equipment for best quality of service, and all such equipment with accessories shall be deemed to be included in the scope of Contractor and no extra payment shall be made to the Contractor for these. The Contractor shall have to visit the site to take physical dimensions of the site to verify horizontal / vertical dimensions etc. before submission of proposals. The bidders may raise the queries for any clarification, missing information or ambiguity if any, within one week after issuance of tender documents. Any work to be carried out by the Contractor, should be mentioned clearly along with the bid, otherwise no claim against extra work shall be acceptable. Specification, Drawings and BOQ etc. should be read carefully to comply with specified conditions and other general and special safety features. Any deviation from specification / BOQ should be mentioned well in time before submission of bid.

Access Control System (ACS) and Intruder Detection System (IDS) works are to be performed as per the requirements given in the specifications. The Contractor shall be responsible and provide the following:

- Provide the necessary hardware and software for above System.

• All the Major equipment of Access Control System (ACS) and Intruder Detection System (IDS) E.G Controllers, Access cards, proximity cards, electromagnetic locks, push button and emergency break glass shall be provided from the same manufacturer.

- All software packages shall be provided in original installation media along with their licenses.
- Preparing an Engineering Design Report covering, at least, the following:
  10) Detailed Drawings for the Access Control System (ACS) and Intruder Detection System (IDS).
  11) Schematics and interconnection diagrams showing Access Control System (ACS) and Intruder Detection System (IDS) components.
  12) The exact quantities and types of hardware and software required
  13) Technical details of the hardware and software of the complete systems
  14) Cable, conduit schedules and routing plans.
  15) Details of any civil works required.
  16) Detailed description of the software, user configurable functions and software features to be provided.
  17) Complete details, brochures and pictures of the proposed area.
  18) Installation, testing and commissioning procedures and methodology.
- Procure, transport and deliver equipment and hardware to site, after approval of the above report(s) by the Engineer. No payment shall be made without approval of equipment.
- Design, Install, test and commission of Access Control System (ACS) and Intruder Detection System (IDS) in accordance with the procedures given in the engineering design report. No payment shall be made without approval of design report.
- Submit Factory Acceptance Test procedures along with Schedule of Time
- Provide training to the Employer's personnel.
- Bidder shall submit with his bid the following Documents/Data for all system equipment including control equipment, Hardware Access Control System (ACS) and Intruder Detection System (IDS) and all associated accessories:
  9) Brochures and data sheets of each equipment
  10) Block diagram of the system showing interconnectivity
  11) Bill of Quantities (BOQs) as per specified format
  12) Cost breakup of each equipment
  13) Detail of Cabinets
  14) Test standards and design
  15) End user certificates
  16) International Standards Reports/Certificates

9.15.1. STANDARDS

All equipment shall be of imported origin. Materials/Equipment shall be designed, manufactured, tested and installed according to the BS/IEC/ISO/ITU/EN/CE Recommendations. The latest edition and amendments shall apply in all cases. As a minimum, following shall be applied:

a. EN 55032:2015: Electromagnetic compatibility of multimedia equipment. Emission Requirements

b. EN 61000-3-3:2013: Electromagnetic compatibility (EMC). Limits. Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems

c. EN 50130-4:2011: Alarm systems. Electromagnetic compatibility. Product family standard: Immunity requirements for components of fire, intruder, hold up, CCTV, access control and social alarm systems

d. EN 55024:2010/A1:2015: Information technology equipment. Immunity characteristics. Limits and methods of measurement

e. EN 55022:2010 Information technology equipment– Radio disturbance characteristics– Limits and methods of measurement.

The Bidder shall state in his bid the standards and codes of practice which he proposes for any items of system or equipment not covered by IEC/ISO/ITU/EN/CE Recommendations. If required by the Engineer/Employer, the Contractor shall submit two English language copies of any standard or code of practice.

9.15.2. WARRANTY

The Contractor shall provide warranty for all equipment for a period of three (03) years through authorized local distributor commencing the hand-over and acceptance date to the Employer. No equipment shall be accepted without warranty certificate from the manufacturer. It shall cover all costs for WARRANTY SERVICE, including parts replacement, labor, prompt field service, pick-up, transportation, and delivery. No extra cost shall be admissible for Warranty services.

9.15.3. FUNCTIONAL DESCRIPTION

- Field Proven (3+ years in similar environment) Access Control Systems shall be installed in all the Equipment Rooms and Management Rooms of HPP's Control Center to ensure the safety of Control Centre Operation. The System should be able to ensure that only those individuals who obtain the requisite level of authorization can access the related area; otherwise, the access will be prohibited.
- The system shall be able to monitor and control, in real-time, the location, individual(s) accessing the protected area, time of access of the related area along with the alarm functions.
- The system shall adapt to the characteristics the requirements of multi-level management model and prompt and accurate access authorization.
- The system shall provide the open and standard interface to integrate and exchange data with other systems (if required).
- The system shall be able to independently operate.
- The access control system record shall be stored for at least one calendar year.
- Forward the Central Server Operation Commands to related Main Controller, Local Controller, Electromagnetic Locks and Card Readers.
- The Central Management System Operator shall be able to check (according to the grading and permission) or print out the data logs available.

- Access Control Terminal Operation State monitor shall be able to Check and Receive Automatically the Real-time state of access control terminal while storing all the above-mentioned data.
- The workstation at control center shall be able to graphically simulate the collocation of access control terminal, the communication status, operation status and fault(s) of various access control terminals.
- In case of illegal operation, the workstation at station level shall be able to send out alarm information in time and prompt the operator to pay special attention; the alarm must be confirmed by the operator before removal. The alarm information including the door No., controlled by access control terminal, time and alarm reasons etc. In addition, system shall be able to view the CCTV Footage from the relevant area's surveillance camera(s) in real-time.
- In case of network interruption between the control center workstation and local/main controllers, the ACS shall be able to operate normally, when the network returns to normal, it shall be able to upload data collected during the network interruption time.
- The workstation at control center shall be able to issue operation control commands to single, one group, one category or total access control terminals.
- The system will allow creation of backups for data safety and recovery.
- The following information will cause the acousto-optic alarm and display the time and alarm events in the alarm information:
  7) Device Offline or Damaged
  8) Device voltage is too low or too high
  9) Equipment was illegally opened or damaged
  10) Effort to Enter using illegal card
  11) Door open time is too long
  12) Lock relay did not move but the door is opened by force
- The system has the function of supporting the user to customize the color map display capability, which is used to display the location, the door and the lock position of the event occurrence. The layout of the access control equipment can be simulated, and the communication state, running state and fault condition of the access control equipment can be monitored graphically. When the state changes or failure occurs, the station can be displayed on the screen of the station accurately and in real time. Station work station should be able to display different colors, sound and alarm signals according to different levels of state or fault. The status of access control equipment should be able to reflect the status of different levels of information, all of the state information should be able to automatically update.

9.15.4. SYSTEM CONFIGURATION

The Central Management workstation shall be able to control the complete ACS, such as system operation, authorization, equipment surveillance and control, network management, database management, maintenance management, system data concentrated collection, statistics, storage and search. The main functions shall be as follows

- Local Control Panels shall be installed for monitoring and Control of ACS Equipment including the Controller, proximity Card Reader, Access Card, Electromagnetic Locks, Engineer/Operator workstation, Push Buttons, Cabinet and Enclosures, emergency door release break glass button.
- The Control Panel state monitor and collection of the operation data.
- The ACS Database Management
- Access control of the Authorized Area
- Access Control Card Authorization Management
- Maintenance and management to the whole access control system equipment
- Provide on-line monitor, self-diagnosis, self- restore and on-line repair functions to the system and network and display the network load
- Integration with CCTV System for real-time monitoring of Intruded/Illegal Access attempts areas
- Connection: Preferably IP TCP / or RS485

9.15.5. SYSTEM SOFTWARE

The access control systems PC or LAN application software shall support H.264 and H.265 access control software that utilizing a Windows VISTA, Server 2008, 7, 8, 10 operating system and combining point monitoring, control with integral Photo I.D. Badging, Time and Attendance, Alarm Graphics and system integration (interfacing) for CCTV, BMS, Fire, etc. The application software shall be capable of running on either a single PC or on a multi-user Local Area Network.

TCP / IP network communications shall be utilized to provide user interaction and real-time monitoring to workstations or PC's located anywhere on a LAN or WAN. The software shall be password word protected to allow for operator specific capabilities at each workstation. The access control system application software shall incorporate Point and Click operation with hierarchical tree views and popup menus for ease of use. I/O monitoring and control shall be achieved through animated icons that depict the real- time status of each input or output. The software shall also allow I/O points to be assigned to an Override Group, allowing for multiple inputs and outputs to be monitored and controlled via a single icon.

The access control system application software shall have the ability to support and configure Graphic alarm maps and will provide detailed information regarding any I/O point within the system. The graphic maps will display real-time status of each I/O point with on-line" system monitoring through graphic objects maps and alerts and will allow the system operator to perform manual overrides directly from the map.

Photo I.D. Badging shall be integral feature of the access control application software. The system shall have the ability to import card holder images from a file, capture images from a live video source, or work with any device providing a TWAIN interface. The application software shall have the ability to print and store multiple images. Automatic Image Recall and Verification upon card use shall be an integral feature of the access control Windows, VISTA, Server 2008, 7, 8, 10 application software. The software must support signature pads, multi card access, access after operator's confirmation, elevator access control up to 50 floors, maps with system elements icon bar code and magnetic stripe encoding.

The access control application software shall provide the ability to create simple or extensive Custom History Reports, filtered event reports generation and save in *.xls format. The report function shall allow the operator to define reports by cardholder, input, output, events or any combination of these items.
The software shall be easy to install and it has very friendly graphic interface for operator. “Dynamic help” windows displayed on operator’s desktop deserve attention as a handy user manual. After click in any field of operator’s desktop the description of this position and configuration method of system element is displayed.
The Controllers/software with IP port shall communicate through Ethernet network. System shall support up to minimum 1024 controllers.
In case of Fire Alarm in the Station, System shall be able to cut-off the power supply to all local controllers in a unified manner and release the locked doors.
Monitoring the Operation state of Main controller, Local Controller, Card readers and Electromagnetic Locks.

9.15.6. ACCESS CONTROLLER

The minimum specifications of Controller shall be as per the following:

- No. of Inputs: 12
- No. of Outputs: 05
- Readers port: 4
- Two way control door:2
- One way control door: 4
- Relay: 3A at 24 V DC; 1A at 24V DC
- Connection: Preferably HBus of RS485
- Readers port type: Wiegand
- Card buffer: 20,000
- Event buffer: 50,000
- Supply power: 12 VDC
- Minimum Battery: 12 V / 7 Ah
- Temperature range: -10°C to 55°C
- Humidity (non-condensing): 10% - 90%
- Readers type proximity, magnetic stripe, biometric
- Inputs – wire type / max. length AWG # 22 - 300 m
- Lock output type: relay
- LED and buzzer output: 4
- Extension port: 1 x 4 relays module
- Baud rate: 19200 / 9600 bps
- Certificate: CE, FCC

9.15.7. ACCESS CARD

The minimum specifications of Access Card shall be as per the following:

- Contact less, multiple applications ISO credit card size card with high-speed read/write (13.5 MH Frequency) and data exchange with the reader as specified in ISO shall be used in the system.

- The cards shall be plain white, wiegand encoded, gloss finish on both sides and shall be directly printable on both sides.
- The Minimum cards memory shall 1K.
- The read distance of the cards using relevant proximity reader shall be up to 10 cms, with fast transaction time of less than 100 ms.
- Cards shall be constructed of laminated PVC, with data retention on temperature range of –25 Deg. C to +55 Deg. C.
- Minimum number of entry and exit points 500 nos. cards to be supplied.

9.15.8. ADMINISTRATOR PROXIMITY CARD

Administrator proximity card shall be Unique, MIFARE, HID, Prox, Reader type having operating frequency 13.56MHZ and USB interface.

9.15.9. PROXIMITY CARD READER

The minimum specifications of proximity card reader shall be as per the following:

- The system shall be equipped with keypad proximity card readers with a tamper switch as shown on the drawings. It shall be possible to use different types of cards / readers in the system.
- The Proximity Reader shall be a Uni-Directional Indoor or Outdoor unit designed for mounting on any surface including solid metal. The reader can be mounted behind most building materials such as sheet rock, or it can be mounted with its side against a metal door or window frame. This unit shall have a read range of more than 10cm.
- The Proximity Reader shall be a unitized reader with a standard Wiegand output that connects directly to the access control panel without the use of an interface module. The reader shall be designed to work with any HID / MIFARE / and Unique proximity cards.
- The card reader shall read the encoded data from the access card and/or transponder and transmit the data back to the host panel, giving an audible and visual indication of a properly read card and shall have a hold line that will buffer a card read until the panel has asserted that the information can be sent up line.
- The card reader shall have a re-present mode in which the card must be taken from the reader field for one second before being read again. This feature is required to prevent multiple reads from a single card presentation
- The reader shall be powered from the access control panel (ICP) directly.
- Operating frequency: 125 kHz, 13,56 MHz
- Read range : up to 10 cm
- Output interface : Wiegand
- Output bits : 26 or 37 (HID® Prox), 26 or 34 (Unique, MIFARE)
- Indoor /outdoor : for indoor and outdoor use
- Temperature range : -40°C to 60°C
- Humidity (non-condensing) : 10% - 95%

- Color: Black / White
- Construction: Polycarbonate/ABS/Metal
- Indications: Bi color Green/Red, Amber LED and audible tone
- Cable Requirements: Seven conductor 22 AWG shielded
- Reader Distance: Maximum 300 Meters From the Panel
- Standards: FCC and CE
- Protection Class: IP 66.

9.15.10. ELECTRO MAGNETIC LOCK

The minimum specifications of electromagnetic lock shall be as per the following;

The electromagnetic lock provided shall be suitable for single and double door type having locking sensor, door condition sensor and shall meet following minimum specifications:

- Anti-pull/Holding Force: 1100 lbs or higher (Main Door)
- Anti-pull/Holding Force: 600 lbs or higher (Sub-Building Door)
- Operating Power: 05. A at 12 V DC ; 0.25 A at 24 V DC (adjustable)
- Operation: Fail Safe (Door shall remain Open on Power failure)
- Locking: Using Internal circuitry to sense door closure.

9.15.11. PUSH BUTTON

The minimum specifications of Push button shall be as per the following:

- Contact type: NO / C
- Product Service Life: 500,000 operations
- Type of assembly: Metal
- Temperature Range: -10 to 55
- Operation Voltage Capacity: 3A / 36vdc

9.15.12. EMERGENCY DOOR RELEASE BREAK GLASS BUTTON

The minimum specifications of emergency door release break glass button shall be as per the following:

- Emergency exit button with C / NO / NC contacts
- Abrasion resistant panel with glass
- Color: Red /Green or as approved by the Engineer
- Temperature Range: -10 to 55
- Operation Voltage Capacity: 3A / 36vdc

9.16. UNINTERRUPTED POWER SUPPLY SYSTEM (UPS)

9.16.1. FUNCTIONAL DESCRIPTION

AC UPS of four (04) hours backup shall be provided to power all the equipment and systems of SCADA and Telecom.

- It shall comprise; redundant chargers; battery bank; redundant invertors. The switch over from mains to the UPS supply and vice versa shall be accomplished in less than 5 msec.

- The UPS shall be floor mounted; self-contained and metal clad and shall be suitable for supplying a nonlinear load.
- It shall be possible to open the enclosure front door when the unit is in use without exposing any live contact to touch.
- The UPS shall be an on-line type incorporating a six pulse rectifier and pulse width modulation inverter technology with microprocessor control. It shall incorporate a static bypass switch which shall operate in the event of UPS failure, overload or manual initiation in order to transfer the output supply to mains without disturbance to the output supply.
- The UPS shall incorporate a dc under voltage trip circuit to electronically trip the UPS output in order to protect the batteries.
- The output of the inverter shall be a sine wave having less than 2% THD for linear loads and less than 4% for 50% nonlinear load. It shall be suitable for load power factors 0.7 lag to 0.9 lead.
- The unit shall have a dynamic response such that a 100% step load causes an output voltage transient of less than ± 4% with a recovery time of less than 4 ms.
- For three phase output units the output voltage shall not vary by more than ± 1% for an unbalance of 10%.
- The load crest factor shall not be less than 3: 1.
- The efficiency at full load and 0.8 power factor shall be greater than 88%.
- The unit shall incorporate a monitoring and diagnostics system to provide an audible alarm to provide warnings and fault indication.
- The following parameters shall be monitored:
  k) Inverter output voltage
  l) Battery voltage
  m) Static bypass voltage
  n) Output current
  o) Inverter output frequency
  p) Available battery bridging time at rated load
  q) Available battery bridging time depending on actual load.
  r) Indicators to indicate
  s) UPS status
  t) UPS alarm conditions
- It shall be possible for operations and maintenance personnel to determine the cause of UPS failure by viewing a fault annunciation display or by interrogation of a ‘user friendly’ integral key pad and display unit.
- The UPS shall have an emergency power off facility. This shall be operable both locally and remotely. A 24 V dc emergency shutdown relay shall be provided to accept the remote shut down signal.
- The UPS shall be required to be manually reset after operation of the emergency shutdown.
- The UPS shall provide a volt free contact output to indicate:

d) Warning, i.e. low battery capacity
e) Fault
f) Static bypass in use.

- The UPS shall have an overload capacity of 150% for 30 seconds and shall be protected in the event of a short circuit of the output.
- The batteries shall be housed, either within the UPS enclosure or within a separate matching battery cubicle suitable for location adjacent to the UPS.
- The batteries shall be of the maintenance free sealed for life lead acid type.
- Batteries shall be contained within translucent impact resistant flame retardant polypropylene cases. They shall be designed for low maintenance and shall have a life in service of at least 10 years.
- The cells shall be arranged in tiers to enable a rapid visual check and access for maintenance. Terminals shall be shrouded to prevent accidental contact. The battery enclosure shall be corrosion resistant and ventilated to prevent the buildup of gases.
- Battery sizing calculations shall be based on Standard IEEE 485
- The battery installation shall be supplied complete with all tools etc. necessary for the safe and efficient maintenance of the batteries.
- Warning notices shall be provided for wall mounting to warn of the presence of charge gases.
- The battery supply to the UPS shall be via a fused load break switch disconnected circuit breaker.
- The battery recharge time to 90% of full charge shall be approximately two times the discharge time at full load. Battery charge time shall be optimized with higher charge currents and multi-stage charge methods.

The Contractor shall provide all associated cables including power cable for UPS system.
The Contractor shall design Uninterrupted Power Supply (UPS) for complete ELV system and Co-ordinate the system engineering with electrical power supply, ELV, Communication Rack, Patch Panel etc. Detailed shop drawings shall be submitted before commencement of work for approval of the consultant. Shop drawings shall include all horizontal and vertical cablings layouts, IT room layouts for communication racks etc.

9.16.2. GEL CELL VRLA BATTERY BACKUP FOR 24HOUR

VRLA tubular design deep cycle batteries shall be proposed, the total demand energy shall be calculated for battery sizing and backup time. The battery bank voltage shall be 48 Vdc. The batteries must provide high-quality and achieving superior performance, the manufacturing date must be new and not more than 6 months, suitable for every type of applications especially for solar renewable energy, designed Service Life 10 years with low internal resistance, designed to be deeply discharged. The Battery should provide benefits of being maintenance free, case flame retardant & non-hazardous. The battery bank shall also include battery temp. Sensor (BTS) and the following:
All necessary DC cables between the batteries together and to the battery fuse box to have a complete operational circuit with all bus bars, conduits, clamps, stainless steel

bolts, washers and cable end terminations and all needed materials to complete the job. All DC cables must be sized in accordance with the installation requirements applicable on site, the allowable voltage drop must be less than 1%.

Battery Banks rack from the same manufacturer of the batteries with dividers and all needed accessories to finish the job. The rack must be enough to carry all the weight of the required batteries for the system.

Contractor must submit all the required certificates for all Battery Banks.

The battery bank for UPS system shall have following minimum features

- Best for cyclic applications
- High temperature tolerance
- Excellent for deep discharge
- Positive plate protective design
- Thicker plate for reduced Grid corrosion and increased cycle life
- High resistance to water loos and shorting
- Maintenance free operation
- Spill proof construction

All works and materials must be according to the drawings, specifications and supervisor engineer instruction's and approval.

9.17. DR DATA CENTER

DR Data Center shall comprise of Blade Server, Video Servers/Processors and Video archiving, Video Recorder(s), IP Contact Center, Video wall and Work Stations. Video Storage of 72 Hours shall be provided. Specifications of Blade Server and Video Server/Processor/storage shall be equivalent to the Blade and Video Server for Primary Data Center. Software Licenses shall be included for creating video walls on the operator's machines where they can see the output of multiple cameras on a single screen. This DR DATA CENTER shall be hosted either in Hyderabad or Sukkur Main Toll Collection Building with backup recording features for 72 Hours and viewing facility of all cameras.

9.18. CONSTRUCTION OF TCC, TIER-III PRIMARY DATA CENTER BUILDING

Modern and state of the art control center buildings for TCC, primary data center and DR DATA CENTER shall be constructed using architects who have expertise in global contemporary control room centers. TCC shall be housed in around 3,000 sq. ft. of land to be constructed with two stories and a basement having total covered area of approximately 33,000 sq. ft. TCC shall host the Tier-III Data Center, temperature/humidity controlled with HVAC system, etc.

Design of the TCC shall follow the guidelines listed hereunder:

t) All windows shall be double glazed tempered/blast proof glass.
u) Fire rated doors shall be provided as per firefighting codes.
v) Provision of cavity walls for insulation is recommended.
w) Entrance ramp ratio shall be as per standards.
x) Provision of electric room and HVAC Plant room shall be made.
y) Provision of janitor room in female and male washrooms shall be made.

z) Internal architectural finishes and specifications including floor tiles, acoustics wall cladding and ceiling layout shall be as per international standards/practices.
aa) Detailed Elevations and Sectional Drawings of the Building shall be included.
bb) Schedule of finishes shall be included in the design.
cc) Landscaping details shall be included in the drawings.
dd) Furniture inventory and specifications shall be included.
ee) Cable networking/trenches/cable tray/raised flooring shall be provided as per standards.
ff) Provision of handicap toilet shall be included.
gg) Water drainage system for the Primary Data Center shall be incorporated.
hh) Provision of natural light and ventilation in the basement and other Floors shall be made.
ii) Architectural composition of the Facade and Building Massing shall be designed keeping in view of local indigenous Architecture.
jj) Overall 3D View showing Building map, surrounding Entry/ Exits and Parking shall be provided.

Six Entry/Exit check-posts are also required to be constructed. All these facilities shall be furnished and equipped with reasonably good quality and standard. The emergency control room has already been constructed, but would need to be renovated with the video wall and furnished with desk operators/office desks/other furniture.

9.19. INTEGRATION OF EXISTING AND UPCOMING RING ROADS

The Contractor shall provide various operational challenges required for integration of ITS software for Sukkur – Hyderabad Ring Road. Interoperability shall continue to present one of the greatest challenges, particularly with video management systems, video recording devices and cameras. The most common scenario shall be that Ring Road has several different management systems for Ring Road operations that are created by different manufacturers, each with proprietary interfaces for integration. The systems shall integrate with each other in Ring Road is discussed in way that which system will talk to which system (Integration of system with system).

The Contractor's detailed design and equipment of ITS System shall be based on Open Standard Protocol for Sukkur – Hyderabad Ring Road and it shall be ensured that the proposed systems shall integrate with existing and upcoming Ring Roads.

9.20. KEY PERFORMANCE INDICATORS (KPIS)

The Contractor shall develop Key Performance Indicators (KPIs)/Metrics of the proposed Intelligent Transportation System according to the latest international standards and best engineering practices. The Contractor shall also coordinate with the Employer during the preparation of design, key performance indicator parameters of ITS systems and tender documents for this project.

10. GENERAL REQUIREMENTS OF THE PROJECT

The requirements listed hereunder are globally applicable to this document.

1. All systems shall be integrated to M-5 Ring Road.
2. Every System/Subsystem of the Rawalpindi Ring Road (RRR) shall be expandable to incorporate more Pole Sites / Toll station Stations / Entry-Exit points as per the requirements of the LEA/Stakeholders and to accommodate/integrate future requirements of Smart Ring Roads with a broader provision of data mining.
3. Design parameters shall confirm to the KPIs and details shall be incorporated accordingly.
4. System Design shall be finalized incorporating all the Earthing/Grounding/Lightening Protection details as per the applicable standards.
5. All the Software(s) of systems/subsystems shall be supplied with life time Licenses.
6. Design documents shall comprise of BOQ, Overview Plans, Block or Architecture Schematic or Drawings, Control hierarchies, Data Flow Diagrams or Single Line Diagrams, integration drawings for Systems and Sub-systems, cabinet internal layouts, equipment layout (flooring plan), manufacturer brochures/technical literature, sizing calculations/simulations, type test certificates, operating manuals, reference list, cable schedules, Functional Design Description, Flow Diagrams, etc.
7. All the equipment shall be supplied to the site after acceptance of Factory Acceptance Test to be carried out in the presence of or to be witnessed by Consultant Representative.
8. A formal Site Acceptance Test shall be carried out at site and shall be witnessed/approved by Consultant's representative.

10.1. COMMUNCATION SERVICE CABLING NETWORK INFRASTRUCTURE

10.1.1. GENERAL

Work in this section includes supply, installation/laying, termination, testing, labeling, certification and commissioning of a high quality ELV/Communication Cabling Works as per BOQ, drawings and technical specifications.

Followings items should specifically be included in the scope of Contractor.

a. Co-ordinate the system engineering with electrical power supply, Uninterrupted Power Supply (UPS), ELV and Communication Rack, Patch Panel etc. Detailed shop drawings shall be submitted before commencement of work or material procurement for Consultant's approval. Shop drawings shall include all horizontal and vertical cablings layouts, IT room layouts for com racks etc.
b. After installing the works the contractor shall provide the equipment required to test the installation prior to the commissioning.
c. The contractor will closely co-ordinate all other activities to coordinate with the structured cabling work.
d. The contractor shall after completion of cabling works test all connections of entire work for connectivity and relevant variables record all test results and provide within 30

days of completion of works a detailed test report and an original certificate by the equipment / cable manufacturer.

e. Any material found not up to the required standard shall be immediately dismantled and / or removed from site by the contractor without claim extra payment.

f. Any theft of equipment shall be the responsibility of the Contractor and no extra payment shall be made for the theft item.

10.1.2. CABLING STANDARDS

All Copper / Optical fiber cabling, components, connecting hardware, installation and testing shall be in accordance with the latest revision of the following standards:

- ISO/IEC 11801: Information technology – Generic cabling for customer premises
- ISO/IEC/TR3 8802-1: Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements
- ISO/IEC/8802-3: Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications
- ISO/IEC 61935-1: Specification for the testing of balanced and coaxial information technology cabling – Part 1: Installed balanced cabling as specified in ISO/IEC 11801 and related standards
- IEC 60364-1: Low-voltage electrical installations – Part 1: Fundamental principles, assessment of general characteristics, definitions
- IEC 60950: Information technology equipment – Safety – Part 1: General requirements
- EN50173: Information technology. Generic cabling systems. Office spaces
- EN50174-1: Information technology. Cabling installation. Installation specification and quality assurance
- EN50174-2: Information technology. Cabling installation. Installation planning and practices inside buildings
- ANSI/TIA/EIA-568 – 568B: Commercial Building Telecommunications Cabling Standard
- ANSI/TIA/EIA – 569: Commercial Building Standard for Telecommunications Pathways and Spaces
- TIA/EIA TSB-72: Centralized Optical Fiber Cabling
- TIA/EIA TSB-75: additional horizontal cabling practices for open offices
- BICSI Telecommunication Method Manual: Telecommunications Distribution Methods Manual
- IEEE 802.3: Ethernet Working

10.1.3. HORIZONTAL CABLING

The horizontal cabling is the portion of the telecommunications cabling system that extends from the work station telecommunications outlet to the floor distributor / communication rack in the Communication rooms. It consists of the telecommunications outlet/connector, the horizontal cables, and that portion of the cross-connect in the telecommunications

closet serving the horizontal cable. Each floor of a building should be served by its own Horizontal Cabling system.

10.1.4. COMMUNICATION CABLES

All STP and fiber optic cables shall conform to ANSI/TIA/EIA-568-B Commercial Building Telecommunications Cabling Standard and ISO/IEC 11801 CLASS EDITION 2: 2002 CLASS E, AS/NZS 3080:2003 CLASS E(International) Generic Cabling for Customer Premises standard.

10.1.5. CATEGORY STP 7 CABLES

Cat STP 7 cables shall be:

- Be provided by the connecting hardware manufacturer.
- Be 100 ohms 4-pair, Category 6 CM for horizontal and CMR rated for vertical backbone with standards TIA/EIA 568-B Category 6, ISO/IEC 11801 Cable or latest.
- The cables shall have;
  - No. pairs 4
  - Conductor 23AWG solid copper.
  - Insulation Thickness 0.22mm
  - External sheath Flame Retardant PVC
  - Operational Temperature range -20oC to 70oC
  - Characteristic Impedance 100ohms + 5 ohms

10.2. CABINETS AND PANELS

10.2.1. PATCH PANELS

The CAT 7 Patch Panel shall be designed to maximize signal integrity and performance throughout the Gigabit Ethernet range.

The patch panels shall have the following minimum features:

- Corrosion resistant sheets
- Fire-retardant, high impact plastic/Metal
- IDC contact material (phosphor bronze with tin plating over nickel)
- Sturdy aluminum plate around RJ 45 Jacks
- Termination accepts 24 and 26 AWG solid wires
- Standard: ANSI / TIA/EIA 568B.2, CAT 6
- Mount standard 19″ rack or cabinet
- Patch panels shall be ideal to work between horizontal subsystems and equipment subsystems
- Front cable organizer shall be used for voice and data patch panel

10.2.2. 18U CABINET STANDALONE RACK

The 18U Data Temperature Control Outdoor cabinet shall have minimum the following Features;

- Power Coated 3 No. Cooling Fans, Cable Manager
- Glass front door without vented hole
- Steel rear doors without vented hole
- Front and rear doors with elegant lock
- Front and rear door are free solder reinforcement structure
- 2 No. PDU 230VAC - 2 No, Cable Channel 100mm
- Earthing Strips 150mm H - 1 No,
- Door Lock - 1 No, Front Metal Band - 1 No. In the rack there must be maintained 1U = 1.75 inches' space.
- 10A, 220V socket link with UPS line
- Minimum Thickness: 4.00mm, mounting angle 1.5mm
- Earthing Bolts
- Degree of Protection: IP 68

10.2.3. 27U CABINET STANDALONE RACK

The 27U Data cabinet shall have minimum the following Features

- Power Coated, 4 No. Cooling Fans, Cable Manager
- Glass front door without vented hole
- Steel rear doors without vented hole
- Front and rear doors with elegant lock
- Front and rear door are free solder reinforcement structure
- 2 No., PDU 230VAC
- Earthing Strips 150mm H - 1 No,
- Door Lock - 1 No
- 10A, 220V socket link with UPS line
- Minimum Thickness: 4.00mm, mounting angle 1.5mm
- Degree of Protection: IP 66

10.3. WARRANTY

10.3.1. SYSTEM WARRANTY

At least 25 years Systems Warranty for Structured Cabling System shall be provided for an end-to-end Channel or Permanent Link Warranty which covers applications and components on all passive telecommunications equipment and cable.

10.3.2. PRODUCT WARRANTY

The manufacturer of passive telecommunications equipment used in a manner not associated with the Systems Warranty must have a minimum 20-year Component Warranty on all its product. The Products Warranty shall start from the date of purchase of equipment and shall cover the components against defects in material or workmanship under normal and proper use.

10.3.3. WARRANTY, TOLERANCES AND REJECTION

The Contractor shall provide warranty for all ELV equipment for a period of three (03) years through authorized local distributor commencing the hand-over and acceptance date to the Employer. No equipment shall be accepted without warranty certificate from the manufacturer. It shall cover all costs for WARRANTY SERVICE, including parts replacement, labor, prompt field service, pick-up, transportation, and delivery. No extra cost shall be admissible for Warranty services.

The Contractor shall furnish a Certificate of Compliance for each major equipment jointly signed by the Contractor and the manufacturer of the equipment that the equipment conforms to the standards and all other requirements laid down in Contract Specifications and that both the Contractor and the manufacturer assume joint responsibility in respect of performance of the equipment.

During and/or after the installation of equipment, manufacturer's representative for each equipment shall visit the site and shall verify that the equipment has been installed as per manufacturer's instructions and the Certificate of Compliance, jointly signed by the Contractor and the manufacturer shall also cover any amendments/modifications made in the installation by the Contractor with due approval of the manufacturer. All costs in this connection shall be borne by the Contractor.

All equipment and material shall be so designed that the tolerances according to the relevant IEC and other applicable standards and regulations as well as the special requirements for the overall equipment are adhered to, and must demonstrate compliance both at the manufacturer's works and at site. Should the equipment/material fail to meet the warranties after due account has been taken of the specified tolerances, the equipment/material will be made available to the Contractor so as to allow the Contractor to carry out rectification on the equipment/material by modifying or replacing defective or wrongly designed parts or equipment/material as a whole.

If the warranted values are not achieved even after remedial work has been carried out, the Employer may reject the equipment(s) as a whole or that part of the system which is causing the non-fulfillment of the warranty or the completion of system.

If an item of equipment/material has to be rejected because of major deficiencies which are not remediable, then such plant or item shall remain available to the Employer free of charge until such time as a replacement is ready for installation. All costs for such rectification shall be the responsibility of Contractor. Any work which does not impair serviceability and integrity of equipment/material as a whole shall not be deemed as violating the warranty obligation of Contractor, provided that the Contractor remedies that within 4 weeks.

The Contractor shall warranty to complete all work called for, so that equipment and material supplied by him are ready for connection and operation within the given period.

The decision regarding the acceptability or otherwise of the equipment and material offered shall be made by the Employer / Engineer whose decision shall be final.

10.4. DEFECTS LIABILITY PERIOD

The Defects Liability Period is one year (365 days) after the date of taking over of the EPC Works as certified in Taking-Over Certificate but subject to extension.

1.2 TERMS OF PAYMENTS

The cost of all design, Supply material, equipment, labour, services, etc. required in accordance with the Contract, which is acceptably designed, supplied, installed, configured, programmed, tested and commissioned as specified and accepted by the Employer and Engineers, shall be considered to be included in the amounts stated against each item of the BOQ.

For items with specified quantities as given in the BOQ, adjustment shall be made in the amount payable to the Contractor in accordance with the actual quantity of work acceptably completed by the Contractor. The payment shall be made at the unit rates stated in the Schedule of Prices.

Payments of supply of major items of equipment Provided always that interim payments of the price of the equipment and materials of BOQ items for Video Scoring Board, Structure and Foundation shall be made as follows

1) 1st Installment
   An Amount of Up to 10% of the price shall be paid by the employer after approval of technical submittals of equipment by engineers.

2) 2nd Installment
   An Amount of Up to 10 % of the price shall be paid by the employer after approval of Design by engineers.

3) 3rd Installments
   Up to 10% of this price shall be paid by the employer to the contractor upon the submission of performing FAT and shipping documents.

4) 4th Installments
   Up to 40% of this price shall be paid by the employer to the contractor after delivery of equipment at site.

5) 6th Installments
   Up to 30% of this price shall be paid by the employer to the contractor after installation and testing of complete ITS Systems and approval of engineers.

10.5. USE OF PROVEN TECHNOLOGY OF ORIGINAL EQUIPMENT MANUFACTURER (OEM) AND COUNTRY OF ORIGIN

The Country of Origin and Manufacturer of the All ITS system Equipment's shall be at

d) USA
e) Europe

The equipment of All ITS Systems shall be designed, supplied, manufactured and assembled at the above countries only.

The Original Equipment Manufacturers (OEM) ITS Systems, the Contractor shall clearly identify the following;

5) Brand of the equipment,

6) OEM Headquarter country

7) Place of manufacturing
8) Distributer / Partner in Pakistan who shall provide local maintenance and Operation assistance.

The manufacturer's C.E.O / MD shall submit a certificate to the Consultant Engineers and Client that ITS System for Ring Road Rawalpindi Projects equipment's shall be manufactured in USA and Europe Factory only which shall be verified by Consultant Engineers.

Local Distributer / Partner reference shall include at least (but not limited to)

- Company name,
- Address in Pakistan,
- Contact persons,
- Phone numbers,
- Valid Email addresses
- Authorized distribution / partner certificate / Specific Project letter from OEM.

Equipment manufactured other than the above countries are not acceptable. Failure to comply with this requirement will result in rejection of the manufacturers. The Contractor shall clearly mention in his bid the origin of the equipment that he is offering. The manufacturer shall have a minimum of 20 years' experience in the design, manufacturing and installation of similar types of systems.

The equipment shall only be acceptable from the list of manufacturers attached herewith. In case of non-availability of specified brands mentioned in the technical specifications, the Contractor shall provide certificates from the Authorized Local Distributor / Partner in Pakistan confirming that the mentioned brand is not available in Pakistan.

In case if the offered equipment is not available, then the detailed type tests shall be carried out by the Contractor in International Independent test laboratory in the presence of Client and Consultant SCADA and Telecom Engineer representatives to establish conformance to specified international codes and standards without extra payment. The Consultant shall provide list of international accredited laboratories where the type test shall be conducted.

10.6. TESTS, INSPECTION AND PROCUREMENT

10.6.1. GENERAL

All type and routine tests on each equipment shall be performed at the manufacturer's works in the presence of the Engineer or his representative. Type tests may be waived off in case test certificates as certified by an approved standard laboratory of repute approved by the Engineer. Submission or merely producing the type test certificates shall not relieve the Contractor to carry out the required standard/routine tests.

The Contractor shall inform the Engineer about the date and time of test of each equipment at least two weeks in advance. The witnessing of test by the Engineer or his representative shall not absolve the Contractor from his responsibility for the proper functioning of the equipment, and for furnishing the guarantees. All test results shall be supplied in triplicate.

10.6.2. TEST AND INSPECTION

Within two months of the commencement date the Contractor shall submit for the approval of the Engineer a Test and Inspection Plan for all items whether at the manufacture's location, the Site or elsewhere up to the date of taking over certificate in accordance with the provisions of the Contract. Such plan shall be in two parts covering factory tests and site tests respectively. The plan shall include a description of the item or part of the Works to be inspected or tested, the nature and frequency of the inspection and testing, the type and size of samples to be taken (if any), the means of recording the test and inspection data, the name and specific responsibilities of any proposed test and inspection agency and all other information necessary to describe the test or inspection to be performed. Not later than two months prior to the commencement of any particular test full details of the proposed method of test, test parameters and test circuits shall be submitted for the Engineer's approval and following such approval shall become part of the Test and Inspection Plan.

Such plan, as approved and modified by the Engineer, shall be used for the inspection and testing and shall be revised and resubmitted for the Engineer's approval if the Contractor desires to change the sequence, method or nature of the test or inspection or if such a change is required by changes in the Work Program or scope of the Work.

Measuring equipment shall be subject to the Engineer's approval and, if required by the Engineer, it shall be calibrated at such independent laboratory as may be agreed. The cost of any such calibration shall be demand to be included in the BOQ rates and prices.

The cost of all tests required by the Specification, including the cost of providing samples where needed, shall be borne by the Contractor.

No approval of tests or inspection of the Work or portions of the Work by the Engineer shall relieve the Contractor of his responsibility to complete the Work according to the Specification, including the satisfactory execution of all necessary site inspections and tests nor shall it relieve him of his duties and obligations under the Contract.

10.6.3. FACTORY ACCEPTANCE TEST (FAT)

Factory Acceptance Test procedure shall be prepared by Bidder along with Quality Assurance Plan. The document shall be subject to Engineer approval.

All ITS and Extra Low Voltage (ELV) System equipment shall be tested in the factory prior to clearance for shipping. The FAT shall include individual equipment tests under fully assembled condition.

The FAT shall demonstrate adherence that the equipment meets the design standards and functional compliance. One (1) month prior to the FAT, Bidder shall submit a test procedure to the Engineers for approval. Duration of FAT at manufacturer's works shall be at least two weeks.

Owner's representative may, at Engineers sole discretion, attend the FAT. In this event, Bidder shall ensure all tests shall be carried out in the presence of Engineer personnel. If Engineers declines to attend the FAT, Bidder shall carry out these tests and submit the results to Engineers for review. Factory Acceptance Tests (FATs) shall be documented with the results obtained and the success or failure of the test. The test results shall be

submitted to Engineers prior to clearance of the FAT and authority by Owner is given to ship.

"All major ITS and Extra Low Voltage (ELV) System equipment to be supplied under this Contract which has been manufactured in or outside Pakistan shall be subject to inspection by Employer/Engineers or its authorized representative at its points of original manufacture before its dispatch to site. The Contractor shall make necessary arrangement and provide all the facilities required for such inspection".

Pre-Inspection Tests and Factory acceptance tests (within Pakistan and abroad) shall be witnessed by the representatives of the Employer and Engineer or any other internationally certified testing agency/body as appointed by the Employer/Engineer. All costs in connection with witnessing of the factory acceptance tests by the representative of Employer/Engineer/testing agency/body shall be borne by the Contractor. In case the factory acceptance test is witnessed by the representatives of Employer/Engineer, the Contractor shall bear all the costs that shall include the costs of first class air travel from Pakistan to place of inspection/testing and back, A class hotel accommodation, boarding/lodging, (as per actual) inland transportation and daily allowance @ US Dollar 200/- per day per person for inspection/testing to be conducted outside Pakistan and @ PKR 15,000/- per day per person for inspection/testing to be conducted in Pakistan for each visit of every person to witness these tests. In case of inspection/testing to be witnessed by other agency, the cost of witnessing the tests as agreed between the Employer and the respective agency will be paid by the Contractor.

Prior to taking over of the works or any section or to putting any portion of the works into service, the Contractor shall carry out Tests on Completion in accordance with the provisions of the Specification. The tests shall be carried out in the presence and to the satisfaction of the Engineer. Contractor shall pay daily/field allowance of PKR 3000/- each to the Employer and Engineer. Daily Allowance shall be paid for each visit till the completion of the commissioning or Start-up, and all this cost shall be deemed to be included in the BOQ rates and prices.

10.6.4. PRE-SHIPMENT TESTS AND INSPECTION

The Contractor shall keep the Engineer informed of the progress of manufacture and notify the Engineer approximately thirty (30) days in advance, in writing as to when the Plant or any part thereof will be ready for testing, inspection and for shipping to wharf at the port of entry/ disembarkation. The tests to be conducted shall include but not be limited to the following:

Prior to shipment to site, at least the following tests shall be performed at the manufacturer's premises, or at the manufacturer's recommended test facilities equipped for such tests:

The cost of pre shipment inspection incurred by the Engineer and the Engineer including inland transportation, round trip air fare, lodging in four-star hotel or equivalent and daily allowance shall be deemed to be included in the BOQ rates and prices. The cost shall be based on anticipated two trips of seven man days each.

Following receipt of such notice, a joint team comprising one engineer each of the Employer and Engineer shall conduct testing and pre shipment inspection of the plant/ equipment or erection equipment or any part thereof including the packing at manufacturer's / supplier's premises and will issue a pre shipment test and inspection report.

In case the Engineer and the Engineer cannot or do not arrange pre-shipment inspection, the Engineer shall issue with the approval of the Engineer, a letter of waiver to ensure timely shipment. The Goods or any part thereof shall be shipped or delivered only upon issuance of pre-shipment inspection report or waiver to pre-shipment inspection by the Engineer.

10.7. PROCUREMENT

Purchase Orders (POs) of complete system equipment's mentioned in the bidding documents are generated by the Contractors and sent to the SACDA and Telecom Engineers for approval. Upon approval, the Pos are sent to the authorized local vendors/Distributors. Upon arrival at site, the equipment shall be cross-checked against the PO.

The following Documents shall also be submitted to SCADA and Telecom Engineer for approval:

a) Project Name shall be written on Purchase Orders
b) Equipment's prices, and delivery times
c) Information regarding specific equipment needed.
d) Warranty Certificates through Authorized Local Distributors
e) Project Name, Site information, contact person's name, telephone number, shipping address, and any other special instructions needed to ship equipment to a site.
f) Purchasing Oder's.
g) Factory Acceptance Test Schedule and time
h) On Manufacture letter Head Project Name, Serial Numbers, labels, logs, and inventory of all equipment's shall be provided.
i) Assemble photographic equipment and perform initial quality assurance checks.
j) Test photographs with the equipment to verify exposure and operation.
k) Assemble the photographic of all system equipment's
l) Operation and Maintenance manual and all necessary photographic monitoring.
m) Package and shipments details.

10.8. SHIPPING

Integrated photographic systems of individual components shall be packed for shipping. All shipments will be made by the most expedient, cost-effective method. Packing slips containing item description, serial number, quantity, weight, and insurance value for all shipments accompany each shipping container. A record of the shipment including a copy of the packing slip will be submitted to Project Manager and SCADA and Telecom Engineers.

10.9. TEST STRATEGY

The Contractor shall be responsible for the development and production of a test strategy and plan, which the Employer project staff and Engineer shall approve prior to implementation. The test strategy shall be written with the objective of proving the performance and functionality of the system in meeting the contractual requirements as stated herein and those subsequently developed and approved throughout the detail design of the project, and in particular within the approved Functional Design Specification. A Verification and Cross Reference Matrix shall be used to document the requirements from the initial bid proposal to final sign off with each requirement mapped to the specific paragraph within the design document, and the Site Acceptance Test that demonstrates that the requirement has been met and proved to have been met by the testing carried out.
The test strategy and plan shall detail:

A. What testing is to be undertaken;
B. When testing is to be undertaken;
C. Who is to undertake and witness the testing;
D. What actions will be taken in the event of failure

10.10. TEST METHODOLOGY AND PLAN

The test plan shall detail the sequence, outline the criteria, define the equipment and test tools which are to be used to facilitate each and every test.
The Employer project staff and the Engineer shall agree with the Contractor's project manager certain tests that will constitute milestone acceptance tests. Those agreed milestone acceptance tests shall be the subject of formal acceptance procedure and must be accepted before proceeding to the next stage.
The Employer project staff shall be given reasonable notice of the time and location of the 'TEST'. It shall not be incumbent upon representatives of the Employer to be present to witness a test unless they so desire.

10.11. CRITERIA AND SPECIFICATION

Not more than six (06) working days after completion of the testing programme, the Contractor shall submit to the Employer project staff three copies of the test package, comprising the following certified documentation of the test:

A. The build and or configuration records of the item(s) tested, including records of any change(s) or repair(s) made to the item in the course of the test and as a consequence of the test.
B. The comments on the execution of the test and the outcome of the analysis of the result.
C. A certified record of the quality and issue status for all the deliverable documentation of the tested configuration.
D. There shall be summaries of the tests undertaken, together with the proposed classification and copies of all observations with the appropriate comments.

10.12. SITE ACCEPTANCE TESTING

Following delivery and installation of the project and supporting services, by the Contractor, to the defined site and the completion of the SAT. The Contractor shall carry out an internal site acceptance test.

The Employer project staff and Engineer shall review the Site Acceptance Test results and once the Employer project staff and Engineer are satisfied that the results show no failures or undocumented design changes the Contractor shall be given permission to start the formal Site Acceptance Test.

The project shall be tested in an operating configuration. All hardware, software and the installed cabling will be subject to testing including PTZ camera, Fixed camera, NVR, Optic Fiber Cable, ODF, Joint Enclosure, SFP module, Network Switch, UPS and Batteries.

10.13. SITE INTEGRATION TESTING

Site Integration Testing will be carried for all the following systems equipment:

1) Optic Fiber Cable (OFC)
2) Routing and Switching
3) Internet Facility
4) Power and Telemetry
5) Solar Power Supply System
6) IP Based Video Surveillance System
7) Electronic Toll Collection System
8) Road Side Weather Information System
9) Variable Message Sign (VMS)/Passenger Information System
10) Traffic Control Center (TCC), Tier-III Primary Data Center and DR Data Center

10.13.1. ACCEPTANCE CRITERIA FOR SAT

The Contractor shall provide a SAT document for review 14 days prior to conducting the SAT. The Employer and Engineer shall review and approve the SAT document prior to SAT.

The SAT documents shall detail various tests related to all systems of ITS.

All workstations in the Central Control room and sub control rooms shall sequentially, access each of the cameras to ensure high-quality and continuous video reception;

The Contractor shall ensure that the above systems shall be tested to work accurately and as specified for operation.

The SAT shall only be successfully completed after all tests have been successfully completed.

A complete SAT shall be performed by the Contractor on the all above Systems elements that shall include but not be limited to;

A. Penetration Testing of Network and Workstations;
B. Testing for failover in real-time by removing cables and power to switches, routers, servers, and all other systems and storage devices to simulate real-life system failures in addition to loss of connectivity in the field to all above systems and other attached equipment

10.14. TEST EQUIPMENT

The Contractor shall provide all necessary certified test equipment and certified specialized test equipment required for fully testing of all above mentioned system including Optic Fiber Cable for the project.

All test software, test tools and test documentation shall be delivered as part of the contract together with the items of test hardware specified by the Contractor as deliverable as well as the measured records of performance of acceptance software and hardware against the test software. Special to project combined test routines developed 'in house' shall be to the same technical standard as other deliverable software. Delivered hardware shall be handed over with specified and actual (tested) performance data.

Contractors shall identify the standards to which their proposed system is to be designed, developed, and tested. As a minimum, Contractors shall conform to the relevant clauses of the published standards, guides and codes of practice, as detailed in the

Standards and Guidelines specified in this document unless alternates are proposed and submitted with the Contractor's response.

10.15. TEST RESULTS

All test results shall be fully recorded and documented by the Contractor and formally submitted to the Employer project staff and the Engineer for approval.

The Employer's project staff and the Engineer will approve site acceptance tests as soon as possible.

The Contractor shall be required to attend and report the progress in writing to the Acceptance Meetings at their expense.

10.16. TESTS ON COMPLETION

Prior to taking over of the SCADA and Telecom system or any section of the system or to putting any portion of the SCADA and Telecom system into service the Contractor shall carry out Tests on Completion in accordance with the provisions of the Specification. The tests shall be carried out in the presence and to the satisfaction of the Engineer and the Engineer. Such tests shall be carried out at the Contractor's risk and not.

Not later than two months before commencement of the tests the Contractor shall submit for the Engineer's approval a detailed schedule of all tests and inspections to be carried out together with complete sets of the proposed measurement, recording and reporting forms for each part of the SCADA and Telecom system equipment's of Following their approval by the Engineer, these submissions shall become part of the Test and Inspection Plan.

The Contractor shall be responsible for the measurement, recording and reporting of Tests on Completion. As each item is completed its completion shall be certified by the Contractor and countersigned by the Employer and the Engineer.

The Contractor shall provide and bear the cost of competent test personnel, instrumentation and test rigs together with all auxiliary personnel, electric power and other services necessary for the completion of the tests.

The Tests on Completion shall verify the correct functioning of individual parts of the SCADA and Telecom system equipment's and of systems involving more than one item of equipment. The tests shall include tests for dielectric withstand, insulation resistance, earth

resistance, correct wiring and connections, correct functions and operating characteristics, calibration of measuring devices and other tests as may be directed by the Engineer.

The Contractor shall give the Engineer 21 days' written notice of the date after which he will be ready to carry out the Tests on Completion. Unless otherwise agreed the Tests on Completion shall take place within 5 days of the said date provided always that the date of commencement of the tests is not later than that set out in the work Program. Following such notice by the Contractor, the Engineer shall appoint the date for commencement of the tests and shall notify the Contractor in writing.

If the Engineer fails to appoint a time after having been requested to do so or to attend at the time and place duly appointed, the Contractor shall be entitled to proceed in the absence of the Engineer and such tests shall be deemed to have been made in the presence of the Engineer.

If in the opinion of the Engineer the Tests on Completion are being unduly delayed, he may by notice in writing call upon the Contractor to make such tests within 10 days from the receipt of such notice and the Contractor shall commence such tests on such day or days within the said 10 days as the Contractor may determine and of which he shall give notice to the Engineer. If the Contractor fails to carry out such tests within the time aforesaid the Engineer may proceed to carry out such tests himself. All costs and losses incurred by the Engineer by reason of such failure and/or by the carrying out such tests by himself shall be borne by the Contractor.

If any portion of the system shall fail to pass the Tests on Completion then tests on the said portion shall, if required by the Engineer, be repeated within a reasonable time upon the same terms and conditions, save that all costs and losses incurred by the Engineer in consequence of such failure and/or by such repetition shall be borne by the Contractor.

Proximate notification of each particular test or inspection shall be given to the Engineer on an approved form not later than three working days prior to the scheduled commencement of the particular test.

10.17. TOOLS, ACCESSORIES AND TEST EQUIPMENT

All tools provided shall be clearly marked with their size or purpose, and these tools shall be neatly arranged in each site in an approved lockable cabinet to be provided under the Contract.

All tools, accessories and test equipment supplied under the Contract shall be new and shall not have been used by the Contractor on the work.

10.18. SPARE PARTS

The Bidders shall submit the list of Spare Parts with his bid. The cost of the spare parts shall be included in the cost of the equipment to be supplied an installed by the Contractor. The list of spares will be prepared by the Bidder on the following basis:

- The spares shall be sufficient for three (3) years of operation.
- At least one module of each type shall be included in the spare parts list, if the total amount of modules is less than or equal to thirty (30).

- If the total number of modules is more than thirty (30), the spare modules to be supplied shall be at least three percent (03%) of the total number of modules (the fractions shall be rounded off to the nearest higher integer).

The Bidder shall demonstrate that the above criteria have been followed while submitting the spare part list.

If during the warranty period, it is found that the quantity of spare parts falls short of the above criteria, the Contractor shall supply the balance spare parts free of cost, to the Engineer.

Bidders shall also list in the Price Schedules of Additional Spares those additional spare parts which the manufacturers recommend should be held to cater for future operation of all equipment supplied under the Contract. A firm price shall be quoted for all items, which shall include for delivery to the Engineer's stores.

The Engineer, at his discretion, may order all or any of the spare parts. Parts ordered within one year of the expiry of the Warranty Period shall be delivered within one month at the prices quoted in the priced schedule.

Spare parts shall be treated and packed to ensure safe transport and a long shelf life without deterioration.

Parts shall be separately packed. A drawing which clearly identifies the part, quotes the part's serial number and gives a clear reference to the maintenance manual shall be enclosed in each pack. In addition, installation instructions shall be included in all packs containing spares for cable joints and terminations.

Parts which are liable to deterioration by atmospheric pollution, humidity or ingress of foreign matter shall be totally sealed in strong polythene bags. Parts which are subject to deterioration due to condensation shall be protected by packs of silica gel or other approved desiccant.

Each packing case shall be clearly and indelibly labeled. The label shall provide the relevant information given in the contract including serial number of contents, shelf life and its expiry date, and where appropriate, lifting and storage/stacking instructions. The shelf life shall be at least five years. Where, because of case size, it is not practical to provide the above information on the packing case, the details shall be given in a sealed waterproof envelope which shall be securely attached to the case.

Cases which contain fragile parts shall have the following notice prominently displayed "FRAGILE – HANDLE WITH CARE"

10.19. STORAGE

Lockable storage shall be provided in each site for all spare parts tools and all other loose equipment.

Proposals for the storage of these, and other tools/accessories (e.g., battery tools/accessories, etc.) shall be submitted to the Engineer for approval. These proposals shall include dimensioned drawings of the proposed storage device, its location, and proposed 157abeling/identification arrangements for the tools/accessories.

10.20. ENGINEERING DESIGN DOCUMENTATION

Bidder will produce drawings of complete system to be submitted to Engineers for approval, indicating upon each the following;

a) Overall dimensional drawing of system cabinet, console and its accessories.
b) Block diagram of system offered with a brief write-up on operation including hookup arrangement with existing system.
c) Data sheets.
d) Bill of Materials.
e) Typical general arrangement drawings of all system equipment
f) Schematic diagram of each type of station.
g) Mounting details.
h) Cable connection diagram for various type of stations, clearly indicating cable size, number of pairs/cores etc.
i) Total power consumption details.
j) Heat load details of panel equipment's.
k) Technical leaflets on each piece of equipment.

The Systems Design Manual shall contain all relevant information pertaining to the design and operation of the delivered equipment.

a) This is intended to provide Owner with an understanding of the operational and design parameters of the equipment and to resolve System operational problems.
b) This documentation shall typically include the following items, presented in a Systems Design Manual:
c) Equipment design calculations and selection basis.
d) Equipment construction and assembly drawings.
e) Parts list and drawings with manufacturer's identification codes.
f) Systems connection diagrams.
g) Accessories list and drawings with manufacturer's identification codes.
h) Test certificates
i) Compliance certificates
j) Quality Control Plan
k) Hazard and Safety Plan
l) Test procedures
m) Recommended and mandatory spare parts List
n) Tools and tackle and consumable list
o) Operation and maintenance manuals
p) Final version of all drawings and documents furnished with the Bid.
q) Shop Drawings
r) Detailed Design Construction Drawings
s) As-Built Drawings

10.21. DRAWINGS AND DATA TO BE FURNISHED BY THE CONTRACTOR

The Contractor, after the award of Contract, shall submit all data and drawings for the approval of the Engineer. Detailed Design shall be responsibility of Contractor. After final approval, three numbers of copies shall be furnished

10.21.1. APPROVAL OF DRAWINGS AND DATA

The Contractor shall submit detailed drawings of all Extra Low Voltage (ELV) system including Single Line Diagram, Wiring Diagrams, Construction Drawings, Shop Drawings and As-Built Drawings for the Engineer's review and approval.

The manufacturing of equipment shall be started only after the above mentioned drawings and data are approved.

The time required for review and approval shall be considered included in the total time of completion of job.

Three sets of drawings including data of each equipment shall be furnished by the Contractor for the Engineer's approval before commencement of fabrication and manufacturing. The drawings to be supplied by the Contractor shall be as follows:

- Detailed Design Construction Drawings
- Shop Drawings
- As-Built Drawings

10.21.2. DETAILED DESIGN CONSTRUCTION DRAWINGS

The Contractor shall submit the following detailed design Construction drawings which include:

A. Construction details of equipment
B. Dimensional plans, elevations and front view.
C. Internal devices/components detail.
D. Incoming and outgoing cable termination positions
E. Detailed Electrical Drawings:

10.21.3. SHOP DRAWINGS

The Contractor shall submit Shop Drawings which includes the locations, routing, spacing, installation and heights of the equipment etc. which are given on the tender drawings. These drawings depict only the position of various equipment and outlets. All the detailed planning for electrical and communication systems including cable tray/conduit routes etc. shall be carried out well in advance of the actual execution of work, by the Contractor to the satisfaction of the Engineer. For this purpose, the Contractor shall prepare shop drawings and obtain prior approval of the Engineer. Three prints of each shop drawings shall be submitted for obtaining approval. No piece of work shall be allowed to be executed at site without the availability of these approved shop drawings. These shop drawings shall clearly depict the load balancing chart of each distribution board. Time required for the preparation and approval of shop drawings shall be considered to have been included in the total time allowed for the completion of the work.

The Contractor shall submit three copies of detailed shop drawings, technical data and schedules for review and approval of the Engineer at least sixty (60) working days prior to execution of work and obtain approval. In general, these detailed engineering shop drawings shall include, but not be limited to the following:

- Shop Drawing Layout Plans
- Server Room Layout Drawing with Equipment Layout

- Detail Calculations for each system
- Shop Drawing Riser / Line / Schematic Diagrams
- General Wiring and Cabling Routing Layout Diagrams
- Conduit and Cable Schedule
- Equipment Layout Drawings
- Combined Services Layout Diagrams (Coordinated with other services)
- Tagging schedules
- Foundation and Trench Arrangement Drawings
- Plans, Elevations and Sections
- Technical submittals of Equipment along with sample
- Testing and commissioning time table
- Testing and commissioning protocols
- Dimensional plans, elevations and front view.
- Internal devices/components detail.
- Incoming and outgoing cable termination position
- Detailed Electrical Drawings showing
    a. Single-Line diagram
    b. Detailed wiring diagram
    c. All interconnections
    d. Other electrical devices including, instruments and their wiring diagram

These above systems shall be complete in all respect as described in these specifications, drawings and BOQ.

The purpose of having drawings and other data checked and approved by the Engineer is to assist the Contractor in interpreting the technical specifications so as to eliminate mistakes in the equipment (type or design) or material actually installed for the work.

The formal approval given to the Contractor is to be considered as in conformance and in no manner shall be construed so as to relieve the Contractor from any liability or responsibility for proper design, fabrication or compliance with the Contract Documents.

The Engineer will review all drawings, manufacturer's catalogues, design calculations, and make changes as required, in order to assist in the overall job coordination and to ensure conformance to the technical specifications.

Engineer's approval must be obtained before equipment is purchased. The Engineer's approval will be general and shall in no way relieve the Contractor of this responsibility for any work required under the Contract.

One copy of each drawing and descriptive data will be returned to the Contractor generally marked.

- "APPROVED"
- "APPROVED EXCEPT AS NOTED"
- "REVISE AND RESUBMIT"

Each drawing/document, which is noted "REVISE AND RESUBMIT" shall be re-submitted after making corrections to the Engineer for further review/comments. The Contractor shall submit four (4) copies of each revised issue thereof.

Minor corrections/modifications will be necessary in the drawings/documents marked "APPROVED EXCEPT AS NOTED". The Contractor shall incorporate the changes marked but does not necessarily resubmit the drawings/documents for further approval.

The Contractor shall allow 15 days (from date of receipt by Engineer to date of dispatch from Engineer's Office) for Engineer's review of each set of drawings in his consideration of schedule of work and in the time allowed for completion of the Contract.

The Contractor shall be responsible for any discrepancies, errors or omissions in any drawings or other particulars supplied by him whether such drawings or particulars have been reviewed by the Engineer or not.

The symbols used for the simplified representation of communication equipment in drawings must conform to DIN or IEC standards. Three copies of the standards will be provided to the Engineer for his reference and record.

10.22. AS-BUILT DRAWINGS

The Contractor shall submit As-Built Drawings. Clearly annotated "As-Built" drawings and diagrams shall be maintained up to date on site on completion of the Job. One reproducible and three prints of each drawing shall be submitted to the Engineer along with a recommended maintenance schedule chart and manuals/operating instructions for equipment supplied. The Contractor shall also provide complete detailed identifications of all Extra Low Voltage (ELV) system.

The Contractor shall provide four copies of final As-Built Drawings and Warranty Certificates of each equipment to Engineer / Employer. As-built drawings shall consist of minimum following:

- Communication networks layouts showing sized, tiers and number of ducts and handholes, cable routing, positioning of each equipment of each system
- Schematic diagrams for proposed fiber optic networks showing connectivity of all cables.
- Server and communication room / closet layout plans showing all systems
- Layout drawings showing exact location of each device and route of cable.

10.23. NOTICE TO DELIVER

The Plant or any part thereof shall be shipped or delivered only upon an authorization in writing (hereinafter called the "Notice to Deliver") which shall be applied for and obtained by the Contractor from the Engineer that the Plant or any part thereof may be shipped or delivered. The Notice to deliver will be issued within 15 days from the date of receipt by the Engineer of the Contractor's valid application.

10.24. INFORMATION TO BE PROVIDED WITH BID

Bidders shall submit the following eligibility requirements along with their bid:

- The Bidder shall provide the information required in BOQ as per technical specifications.
- Printed Brochures providing detailed specifications for each piece of hardware and proposed software from at least three vendors shall be provided.

- Bidder shall provide make, model and manufacture of complete hardware and software
- Block and conceptual diagrams of system showing various pieces of hardware and their interconnection
- Write-up giving modus operandi of the system and details of the solutions proposed for transmission of voice and data along the network
- List of Spare Parts, Tools and Test Equipment

Bids found deficient in any part of the information asked above shall be liable to be declared "NON RESPONSIVE" to the Engineer's requirements.

10.25. REQUIREMENT FOR SUB-CONTRACTOR

The Subcontractor shall have and submit the following:

- Valid license from PEC in the Construction as well as Operations Categories and meet the relevant category and requirements of Construction Category and Operations Category
- Project Profiles with detailed information of EPC based Design, Supply, Installation, Testing and Commissioning of SCADA/Automation/Extra Low Voltage Projects such as Scope, BOQ, organization chart, architecture Diagram and any other document necessary including substantial completion/taking-over certificates should be attached
- Company Profile including general information
- Details of projects of similar nature, projects of EPC/Turnkey nature in hand and completed projects
- Project cost executed over the period of last 5 years. Contractor is required to submit Project Profile(s) with detailed information, such as Scope, BOQ, and any other document necessary for this application including substantial completion/Taking-Over Certificates should be attached
- Bidder shall have on its permanent payroll Graduate Engineers with minimum 10 years of experience. 50% of staff of the above mentioned engineers are SCADA/Automation/Electrical Engineers/Extra Low Voltage
- Bidder shall be required to make a project team and nominate experts and shall submit detailed CVs for the Project Positions/Key Experts for the Project
- List of permanent Tools, Equipment, hardware available in the office, currently in the custody of the Firm used to assist in execution/construction/system integration/commissioning, Electrical/Instrumentation/Testing/Calibration Tools, Computers/Servers/Printers shall be submitted
- Average Annual Turnover of last 5 years from recognized audit company shall be submitted
- Financial Capabilities including details of total assets, Current assets, total liability, current liability, profit before taxes and Net Worth from recognized audit company shall be submitted
- Bidder should not have been black listed by any Governmental or semi-Governmental Organization/Department anywhere in the world. Contractor should submit an

Undertaking with the Application, certifying that “the Applicants’ Firm(s) has/have not been blacklisted by any Government or Semi-Government organization” anywhere in the world.

10.26. LIST OF MANUFACTURERS/SUPPLIERS

While procuring material related with any engineering discipline, the responsibility shall be upon the Contractor for establishing the genuineness of any material/product/item for its make and origin as specified below. The supplier of the items must have authorization certificate from principal/manufacturer for the sale of equipment in Pakistan with installation, testing, commissioning & O&M facilities as required. The equipment /items shall be from following recommended brands or equivalent in conformance to the specified requirement.

Electronic Toll Collection, Weigh Station and Weather Information	
1	G.E.A France
2	Kapsch Trafficcom Austria
3	Siemens Germany
4	Q- Free Norway
5	Glonass Russia
IP Based Video Surveillance System	
1	Axis Sweden
2	Avigilon Motorolla Canada
3	NOVUS Europe Poland
IP Based Public Address System & Voice Evacuation system	
1	Ambient Europe
2	Bose USA
3	Ecler Europe
4	Boyer France
IP Based PABX &Telephone System	
1	Avaya USA
2	Siemens Germany

3	Cisco USA
4	Alcatel France
Access Control And Intrusion System	
1	Johnson Control USA
2	KADE Europe
3	Garret USA
Video Conference System	
1	Poly COM
2	CISCO
3	AVAYA
4	TRIUMPH Europe
Networks & WI-FI system	
1	Cisco USA
2	Juniper
3	OPTOKON Europe
Public Address/VA System Cables	
1	Belden USA (LSZH Cable)
2	FP-200 Gold UK (LSZH Cable)
3	Don caster (LSZH Cable)
Power Cable	
	Pakistan Cables
	Pioneer Cables
	Newage Cables
	Fast Cables
PVC/HDPE Pipe Conduit & Accessories	
	Beta
	Popular
	Dadex
Steel Conduit & Accessories	

	Hilal Industries
	IIL
	Jamal
	Spleen
STP Cables, Coaxial Cables, Fiber Optic Cable, Computer Networking Cabling, Racks & Accessories.	
	Primer Cable Pakistan
	Panduit USA
	i-Connect UK
Servers /Workstation	
	Dell
	HP
UPS	
	Siemens
	General Electric
	ABB
	i-Power UK
	Ericson
Printer	
	HP
	Cannon
SMD Video Wall and SMD Advertisement Display	
	Mitsubishi
	EKTA Europe
	Barco USA