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1.0 GENERAL

1.1 SCOPE

- 1.1.1 This section of the specification describes and specifies requirements for the supply, delivery, installation, testing, commissioning, handing over in approved working order and maintenance during the Defects Liability Period of the whole Closed Circuit Television (CCTV) System in accordance with the Conditions of Contracts, Bill of Quantities, Drawings and other related documents.

1.2 TECHNICAL PARTICULARS


- 1.2.1 Tenderers shall submit at the time of tendering all catalogues, detailed technical particulars and guarantees in respect of the equipment offered, which shall be binding. No departure from these technical particulars and guarantees shall be permitted except with the written approval of the Superintendent Officer (S.O) or S.O's Representative.

1.3 GUARANTEES

- 1.3.1 The tenderers shall guarantee all equipment to be supplied under this contract against faulty design, material and workmanship at the manufacturer's works within the Defect Liability Period (DLP).

1.4 ELECTRICAL SYSTEM

- 1.4.1 All equipment shall be rated for operation on a 230/400 V (within the tolerance as defined in MS IEC 60038; 230/400 V, +10%, -6%), 3 phase, 4 wire, 50 Hz system with solidly earthed neutral.

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2.0 CAMERA

2.1 VARIFOCAL CAMERA


2.1.1 It shall be of dome, bullet or box type as specified in the bill of quantities or drawings. The varifocal camera shall comply with the following minimum technical specifications:-

Image sensor	:	1/2.8" CMOS
Scanning method	:	Progressive
Resolution	:	2688 x 1520 pixels (4 megapixels (MP))
Frame rate	:	25 frame per second (fps) at full resolution
Compression	:	H.265
Lens focal length	:	Varifocal
Field of view (FOV)	:	Horizontal FOV from (40° to 90°) ± 2°
Aperture ratio (f-stop)	:	F1.6 (at widest angle) – a lower number indicates better value
Zoom	:	Motorised
Focus	:	Automatic
Day & night mode	:	Auto true day/night using infra-red (IR) cut filter (ICR)
Sensitivity (F1.6)	:	0.3 ± 0.05 lux (colour); 0.1 ± 0.05 lux (black & white (B&W)); 0.0 lux with IR
White balance	:	Automatic, presets & manual
Wide dynamic range (WDR)	:	88 dB WDR
Network interface	:	10/100 Mbps RJ-45
Multiple streaming	:	Two (2)
ONVIF compatibility	:	Profile G, S and T
Power supply	:	Power over Ethernet (PoE) and, AC or DC power supply
Degree of protection	:	IP66
Vandal resistant	:	IK10
Operating temperature	:	15°C to 50°C
Alarm input & output terminal	:	One (1)
Audio input & output terminal	:	One (1)
IR viewing distance	:	30 ± 5 metre (m)

2.2 PAN, TILT AND ZOOM (PTZ) CAMERA

2.2.1 The PTZ camera shall comply with the following minimum technical specifications:-

Type	:	Pan, tilt and zoom
Image sensor	:	1/2.8" CMOS
Scanning method	:	Progressive
Resolution	:	2688 x 1520 pixels (4 MP)
Frame rate	:	25 fps at full resolution


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Compression	:	H.265
Optical zoom level	:	20 times
Lens focal length	:	Zoom lens
Field of view (FOV)	:	Horizontal FOV from $3^{\circ} \pm 1^{\circ}$ to $60^{\circ} \pm 5^{\circ}$ (at maximum optical zoom level to normal)
Aperture ratio (f-stop)	:	F1.8 (at widest angle) – a lower number indicates better value
Zoom	:	Motorised
Focus	:	Automatic
Pan range	:	360° continuous
Tilt range	:	$\pm 90^{\circ}$
Preset positions	:	255
Day & night mode	:	Auto true day/night using IR cut filter (ICR)
Sensitivity (F1.8)	:	0.3 ± 0.05 lux (colour); 0.1 ± 0.05 lux (B&W); 0.0 lux with IR
White balance	:	Automatic, presets & manual
Wide dynamic range (WDR)	:	88 dB WDR
Network interface	:	10/100 Mbps RJ-45
Multiple streaming	:	Two (2)
ONVIF compatibility	:	Profile G, S and T
Power supply	:	PoE+ and, AC or DC power supply
Degree of protection	:	IP66
Vandal resistant	:	IK09
Operating temperature	:	15°C to 50°C
Alarm input & output terminal	:	One (1)
Audio input & output terminal	:	One (1)
IR viewing distance	:	150 ± 15 m

2.3 PANORAMIC MULTI-SENSOR VARIFOCAI CAMERA

2.3.1 The panoramic multi-sensor varifocal camera shall be of dome type and comply with the following minimum technical specifications:-

Image sensor	:	4 x 1/2.8" CMOS
Scanning method	:	Progressive
Resolution	:	4 x 1920 x 1080 pixels (8 MP)
Frame rate	:	25 fps at full resolution
Compression	:	H.264
Lens focal length	:	Varifocal
Field of view (FOV)	:	Horizontal FOV of each lens from $(60^{\circ}$ to $90^{\circ}) \pm 2^{\circ}$
Aperture ratio (f-stop)	:	F1.8 (at widest angle) – a lower number indicates better value
Zoom	:	Motorised
Focus	:	Automatic
Day & night mode	:	Auto true day/night using IR cut filter (ICR)


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Sensitivity (F1.8)	:	0.3 ± 0.05 lux (colour); 0.1 ± 0.05 lux (B&W)
White balance	:	Automatic, presets & manual
Wide dynamic range (WDR)	:	88 dB WDR
Network port	:	10/100 Mbps RJ-45
Multiple streaming	:	Two (2)
ONVIF compatibility	:	Profile G and S
Power supply	:	PoE and, AC or DC power supply
Degree of protection	:	IP66
Vandal resistant	:	IK09
Operating temperature	:	15°C to 50°C
Alarm input & output terminal	:	One (1)
Audio input & output terminal	:	One (1)

2.4 FISHEYE CAMERA

2.4.1 The fisheye camera shall be of dome type and comply with the following minimum technical specifications:-


Image sensor	:	1/2.8" CMOS
Scanning method	:	Progressive
Resolution	:	9 MP
Frame rate	:	25 fps at full resolution
Compression	:	H.264
Lens focal length	:	Fixed
Field of view (FOV)	:	Horizontal FOV 180°; Vertical FOV 180°
Aperture ratio (f-stop)	:	F2.2 – a lower number indicates better value
Focus	:	Automatic
Day & night mode	:	Auto true day/night using IR cut filter (ICR)
Sensitivity (F2.2)	:	0.3 ± 0.05 lux (colour); 0.1 ± 0.05 lux (B&W)
White balance	:	Automatic, presets & manual
Wide dynamic range (WDR)	:	88 dB WDR
Network port	:	10/100 Mbps RJ-45
Multiple streaming	:	Two (2)
ONVIF compatibility	:	Profile G and S
Power supply	:	PoE
Degree of protection	:	IP66
Vandal resistant	:	IK09
Operating temperature	:	15°C to 50°C

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2.5 CORNER-MOUNT CAMERA

2.5.1 The corner-mount camera shall comply with the following minimum technical specifications:-


Construction	:	Corner mount providing no grip and anti-ligature installation
Image sensor	:	1/2.8" CMOS
Scanning method	:	Progressive
Resolution	:	2048 x 1536 pixels (3 MP)
Frame rate	:	25 fps at full resolution
Compression	:	H.264
Lens focal length	:	Fixed
Field of view (FOV)	:	Horizontal FOV 120° ± 2°; Vertical FOV 90° ± 2°
Aperture ratio (f-stop)	:	F2.2 – a lower number indicates better value
Focus	:	Automatic
Day & night mode	:	Auto true day/night using IR cut filter (ICR)
Sensitivity (F2.2)	:	0.3 ± 0.05 lux (colour); 0.0 lux with IR
White balance	:	Automatic, presets & manual
Wide dynamic range (WDR)	:	Yes
Network port	:	10/100 Mbps RJ-45
Multiple streaming	:	Two (2)
ONVIF compatibility	:	Profile G and S
Power supply	:	PoE
Degree of protection	:	IP66
Vandal resistant	:	IK10
Operating temperature	:	15°C to 50°C
Alarm input & output terminal	:	One (1)
Audio input & output terminal	:	One (1)
IR viewing distance	:	10 ± 2 m
Other features	:	Camera tampering alert; Dynamic masking

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2.6 THERMAL CAMERA

2.6.1 The thermal camera shall comply with the following minimum technical specifications:-

Compression	:	H.265
Frame rate	:	25 fps at full resolution
Network interface	:	10/100 Mbps RJ-45
Multiple streaming	:	Two (2)
ONVIF compatibility	:	Profile G, S and T
Power supply	:	PoE and, AC or DC power supply
Degree of protection	:	IP66
(i) Thermal module		
Image Sensor	:	Uncooled focal plane arrays
Resolution	:	384 x 288 pixels
Pixel pitch	:	17µm
Noise equivalent thermal difference (NETD)	:	≤ 40 mK
Lens focal length	:	Fixed
Field of view (FOV)	:	Horizontal FOV 25° ± 2°
Aperture ratio (f-stop)	:	F1.0 – a lower number indicates better value
(ii) Optical module		
Image Sensor	:	1/2.8" CMOS
Resolution	:	2688 x 1512 pixels (4 MP)
Day & night mode	:	Auto true day/night using IR cut filter (ICR)
Field of view (FOV)	:	Horizontal FOV 50° ± 2°
Aperture ratio (f-stop)	:	F1.8 – a lower number indicates better value
Sensitivity (F1.8)	:	0.3 ± 0.05 lux (colour); 0.1 ± 0.05 lux (B&W)
Wide dynamic range (WDR)	:	88 dB WDR
(iii) Video analytic		
Built-in analytic suite	:	Body temperature detection
Temperature range	:	30°C to 45°C
Accuracy	:	± 0.5°C
Alarm	:	Alarm above set temperature

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3.0 OTHER EQUIPMENT

3.1 NETWORK VIDEO RECORDER (NVR)

3.1.1 The NVR and its associated software shall be fully compatible with all the installed cameras. It shall perform the managing and setting up of cameras, day to day recording operation, live viewing, playback of recorded video and other configuration necessary for the successful operation of the CCTV system. The NVR shall be preloaded with CCTV management software and camera licenses.

3.1.2 The NVR shall comply with the following minimum technical specifications:-

Number of camera channel	:	16, 32, 64 or 128
Camera licenses	:	Built-in for all connected cameras
Video storage capacity	:	In terabytes (TB) as specified in bill of quantities or drawings
Redundant array of independent disks (RAID)	:	RAID-5
Expansion storage	:	In order to fulfil the video storage capacity, external hard disk drive (HDD) expansion storage maybe required. This shall deem to be included in this NVR.
Concurrent connected user	:	Three (3)
Recording & playback resolution	:	2MP to 8MP
Recording bandwidth	:	450 Mbps for 128 channels; 350 Mbps for 64 channels; 250 Mbps for 32 channels; 150 Mbps for 16 channels
ONVIF compatibility	:	Profile G, S and T
Compression technology	:	H.265
Live multi viewing display	:	1/4/9/16/25/36 and auto sequence
Sequence mode	:	4 splits per monitor
Recording mode	:	Continuous, schedule & event
Event trigger	:	Camera event (motion, analytical etc.); Alarm input
Playback	:	Play, pause, stop, forward, reverse etc.; Date/time, timeline & event search
NVR access control	:	Protected user access level
Other features	:	Video loss alert
Camera function support	:	Support the operation of PTZ camera, fisheye dewarping (if applicable), panoramic camera, camera adjustment etc.
Ethernet	:	1 x Gigabit (GbE) RJ-45
Form Factor	:	Rack mount

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- 3.1.3 The NVR CCTV management software and its associated camera licenses shall have perpetual validity. Once the software and licenses are installed, the user shall not be required to perform renewal to ensure the CCTV system will continuously function.

3.2 STORAGE ARRAY


- 3.2.1 The storage array shall be provided as a whole solution satisfying the total storage required. It shall complete with processor, operating system, memory, controllers and fully compatible with the video management software. The storage array shall comply with the following minimum technical specifications:-

Type	:	Rack mount
Video storage capacity	:	In TB as specified in bill of quantities or drawings
RAID	:	RAID-5
Expansion storage	:	In order to fulfil the video storage capacity, external hard disk drive (HDD) expansion storage maybe required. This shall deem to be included in this storage array.
HDD support	:	2.5" or 3.5" HDD hot swap
Network interface	:	2 x GbE RJ-45
Power supply	:	Redundant power supply unit, hot swappable

3.3 MANAGEMENT AND VIDEO RECORDING SERVER

- 3.3.1 The management server shall provide management, monitoring and control of the entire CCTV system. The server together with the video management software shall perform the managing and setting up of cameras, day to day recording operation, live viewing, playback of recorded video and other configuration necessary for the successful operation of the CCTV system.
- 3.3.2 The server shall comply with the following minimum technical specifications or as recommended by the Video Management System manufacturer, whichever is higher:-

Type	:	Rack mount
Processor	:	Intel Xeon processor E5-2600 v4 or equivalent
Number of processor	:	1
Total number of core	:	8
Core speed	:	3.0 GHz
Cache per processor	:	15 MB
Memory	:	16 GB DDR4
Drive bays	:	8 HDD bays;
Internal storage	:	2 TB HDD
Network interface	:	2 x GbE RJ-45


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Operating systems : Latest Microsoft Windows Server
 Included software : Antivirus
 Power supply : Redundant power supply unit, hot swappable

3.4 VIDEO MANAGEMENT SOFTWARE (VMS)

3.4.1 The management software shall be of server and client type. It shall perform the managing and setting up of cameras, day to day recording operation, live viewing, playback of recorded video and other configuration necessary for the successful operation of the CCTV system. The VMS shall comply with the following minimum technical specifications:-

Camera licenses : For all connected cameras
 Workstation licenses : Five (5) concurrent users
 Multi-server support : Yes
 Remote site access : Yes (connection to remote site if specified)
 Fail-over server support : Yes (if fail-over is specified)
 ONVIF compatibility : Profile G, S and T
 PTZ camera support : Yes
 Camera detection : Automatic
 Streaming support : Live and recording
 Record & playback resolution: 2MP to 8MP
 Compression technology : H.264 and H.265
 support
 Live multi viewing display : 1/4/9/16/25/36 and auto sequence
 Sequence mode : 4 splits per monitor
 Recording mode : Continuous, schedule & event
 Playback : Play, pause, stop, forward, reverse etc.;
 Date/time, timeline & event search
 Event trigger : Camera event (motion, analytical etc.);
 Alarm input
 Access control : Protected user access level
 Other features : Video loss alert
 Video analytic solution : Compatible for seamless integration with
 third party and camera built-in analytical
 suites (if specified);
 The VMS shall work together with the
 analytic suites such that when the analytic
 engine detected behaviours fitting the rules
 applied, the system shall generate alarm so
 that user will be able to see the threats and
 respond appropriately;
 Any software development kits (SDKs) if
 required are deemed to be included.

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3.4.2 If the camera and workstation licenses are not separately priced in the bill of quantities, the price of the VMS shall deem to include them.

3.4.3 The VMS and its associated camera licenses shall have perpetual validity. Once installed the user shall not be required to perform renewal or similar process to ensure that the CCTV system will continuously function.

3.5 WORKSTATION


3.5.1 The workstation shall comply with the following minimum technical specifications or as recommended by the VMS manufacturer, whichever is higher:-

Operating system	:	Microsoft Windows 10, 64-bit
Processor	:	Intel Core i7, 2.0 GHz or equivalent
RAM	:	16 GB DDR4
HDD	:	1 TB
Network interface	:	1GbE RJ-45
Display resolution	:	1920 x 1080 pixels
Graphic card	:	1
Graphic adapter	:	512 MB and above
Optical drive	:	DVD-R/W
Included software	:	MS Office and antivirus
Others	:	22" LCD Monitor, USB keyboard and USB mouse

3.6 DISPLAY CENTRAL PROCESSING UNIT (CPU)

3.6.1 The display CPU shall comply with the following minimum technical specifications or as recommended by the VMS manufacturer, whichever is higher:-

Processors	:	Intel Xeon E5-2600 v4 or equivalent; 3.0 GHz, 4 core, 10MB L3 cache
Operating system	:	Microsoft Windows 10, 64-bit
Memory	:	16 GB DDR4
Network interface	:	1GbE RJ-45
Graphic card	:	
Number of display supported	:	As specified in bill of quantities or drawings
Resolution	:	3840 x 2160 pixels per display
Display connector	:	Compatible with the LED monitor
GPU memory	:	8GB GDDR5 for 1 and 2 LED monitors; 16GB GDDR5 for 3 and 4 LED monitors
HDD	:	1 TB
Included software	:	Antivirus
Others	:	USB keyboard and USB mouse

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3.7 LED MONITOR

3.7.1 The LED monitor shall comply with the following minimum technical specifications:-

Type	:	Industrial type suitable for 24/7 operation
Screen size	:	42" (diagonal)
Panel type	:	LED
Aspect ratio	:	16:9
Number of pixels (H x V)	:	3840 x 2160 pixels
Brightness	:	500 cd/m ²
Display connector	:	Compatible with the display CPU graphic card

3.8 SURGE PROTECTIVE DEVICE FOR DATA

3.8.1 The surge protective device for data shall comply and tested to IEC 61643-21 with the following technical specification:-

Connection type	:	RJ45
Maximum continuous operating voltage, U_c	:	≥ 57 Vdc
Voltage protection level, U_p	:	≤ 120 V (line to line) ≤ 900 V (line to earth)

3.9 DC POWER SUPPLY


3.9.1 The DC power supply shall comply with the following minimum technical specifications:-

Output DC voltage	:	Adjustable from 48V to 57V
Rated output current	:	2.7 A
Rated output power	:	150 W
Power factor	:	0.9 at full load
Efficiency	:	80%
Battery backup & charger	:	Yes
Protection	:	Short-circuit; Overload and over voltage
Operating temperature	:	15°C to 60°C

3.10 BACKUP BATTERY

3.10.1 The backup battery shall comply to the following minimum technical specifications:-

Battery	:	Ampere hour (AH) as specified in bill of quantities or drawing
Nominal Voltage	:	48 Vdc (4 nos of 12 Vdc in series)

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Type : Rechargeable sealed lead acid

3.11 POWER OVER ETHERNET (PoE) MEDIA CONVERTER

3.11.1 The PoE media converter shall comply to the following minimum technical specifications:-

Copper port	:	10/100 base-T RJ45; Cat 6 UTP cable
Fibre port	:	100/1000 base-X SC; Singlemode & multimode fibre cable
PoE power	:	30 W (all cameras type except PTZ); 90 W (for PTZ camera)
Input voltage	:	48 to 57 Vdc (if connected to DC power supply with backup battery); or AC / DC complete with power adapter
Operating temperature	:	15°C to 60°C

3.12 MEDIA CONVERTER


3.12.1 The media converter (indoor type) shall comply to the following minimum technical specifications:-

Copper port	:	10/100 base-T RJ45; Cat 6 UTP cable
Fibre port	:	100/1000 base-X SC; Single mode & multimode fibre cable
Input voltage	:	AC / DC complete with power adapter
Operating temperature	:	15°C to 50°C

3.13 PoE INJECTOR

3.13.1 The PoE injector shall comply to the following minimum technical specifications:-

Input port	:	10/100 base-T RJ45
Output port	:	PoE 10/100 base-T RJ45
PoE power	:	30 W (all cameras type except PTZ); 90 W (for PTZ camera)
Input voltage	:	48 to 57 Vdc (if connected to DC power supply with backup battery); or AC / DC complete with power adapter
Operating temperature	:	15°C to 60°C

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3.14 PoE EXTENDER

3.14.1 The PoE extender shall comply to the following minimum technical specifications:-

Input port	:	10/100 base-T RJ45 with pass-through PoE
Output port	:	10/100 base-T RJ45
Input power	:	Through input port PoE
Extended distance	:	90 m
Extended power	:	25 W
Operating temperature	:	15°C to 60°C


3.15 EQUIPMENT RACK

3.15.1 Floor mounted rack shall comply with the following minimum technical specifications:-

Rack size	:	42U
Width / depth	:	800 mm / 1000 mm
Frame / panel thickness	:	2.0 mm / 1.5 mm
Front / rear door	:	Double leaf, lockable and perforated door
Top entry cable slot	:	2 slots with air sealing and cable grommet
Vertical cable management	:	4 angle sides
Power Distribution Unit (PDU)	:	C13 socket outlets rated at 32A complete with 32A 3-pin commando plug
Earthing connection	:	1 no M6 bolt & nut at both sides diagonal position
Blank Panel	:	1U, 2U or 5U
Accessories	:	Castor wheel and heavy-duty adjustable levelling feet


3.15.2 Wall mounted rack shall comply with the following minimum technical specifications:-

Rack size	:	15U
Width / depth	:	600 mm / 800 mm
Frame / panel thickness	:	1.5 mm / 1.2 mm
Front / rear door	:	Single leaf, lockable and perforated door
Top entry cable slot	:	2 slots with air sealing and cable grommet
Trailing Socket	:	3-way 13A 3-pin switched socket outlet
Earthing connection	:	1 no M6 bolt & nut at both sides diagonal position
Accessories	:	Heavy duty wall mount bracket

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It shall be mounted at height not exceeding 1450 mm from the underside of the rack to the finished floor level.

- 3.15.3 Equipment shall be arranged as such to allow for heat to flow and be convected freely, minimising any temperature built-up. All cables shall be arranged in a neat and systematic manner. Internal cables shall be fixed securely without strain.

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4.0 WIRING

4.1 GENERAL

- 4.1.1 General system of wiring, conduits, trunking, cable tray or cable ladder, wiring accessories etc. shall be referred to the latest JKR Specification for Low Voltage Internal Electrical Installation (L-S1).

4.2 SERVICE COLOUR IDENTIFICATION

- 4.2.1 All conduits and trunking for the system shall be clearly identified and distinguished from other services.
- 4.2.2 Trunking for CCTV system shall be identified using black "ACCESS/CCTV" letterings over white background. The letterings shall have a minimum height of 15 mm but need not exceed 50 mm, and at an interval not more than 5000 mm and at any bends. All letterings shall be clearly legible, and to the satisfaction of the S.O or S.O's Representative.
- 4.2.3 Colour bands for conduits identification shall be as specified in the latest JKR Specification for Low Voltage Internal Electrical Installation (L-S1) or as approved by the S.O or S.O's Representative.

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5.0 TESTING AND COMMISSIONING

5.1 TEST INSTRUMENTS

- 5.1.1 All measuring and test instruments used for testing and commissioning of the installations shall be regularly tested and calibrated by the manufacturers or accredited calibration laboratories for their functionality and accuracy. Test and Calibration Reports or Certificates for the measuring and test instruments issued by the calibration laboratory shall be valid for two (2) years from the date of issuance.
- 5.1.2 The instruments and their Test and Calibration Reports or Certificates shall be submitted to S.O or S.O's Representative for verification two (2) weeks before testing of the installations being carried out. No test on the installations shall be carried out without prior approval of the S.O or S.O's Representative. Notwithstanding the validity of the aforesaid Reports or Certificates the measuring and test instruments shall be re-calibrated if so required by the S.O or S.O's Representative after any mechanical or electrical mishandling. Fee required for the testing and calibrating of the measuring and test instruments is deemed to be included in the Contract.


5.2 TEST AND TEST CERTIFICATES

- 5.2.1 After the installation work has been completed and before Certificate of Practical Completion is issued, the whole system shall be tested for compliance and performance as follows:-
- 5.2.1.1 Cables shall be tested for continuity;
 - 5.2.1.2 The whole system shall be properly configured for operation as well as tested for compliance and performance. Equipment shall be properly set up and configured. Functional test shall be performed to indicate correct operation and performance of all equipment; and
 - 5.2.1.3 Any other tests which may be needed to demonstrate the satisfactory function of the system
- 5.2.2 The S.O or S.O's Representative reserves the right to be present at all tests and the Contractor shall give at least one (1) week notice in writing to the S.O or S.O's Representative for this purpose. In any case, no test shall be carried out without prior approval of the S.O or S.O's Representative. Copies of all the test certificates together with As-Installed Drawings properly bound and titled shall be submitted to the S.O or S.O's Representative within one (1) week after the completion of the testing.

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6.0 SERVICE AND MAINTENANCE

- 6.1 During the Defects Liability Period, the Contractor shall be responsible for the service and maintenance work of the complete installation. All works shall be carried out by skilled person. All labour, material, tools and parts necessary to rectify the defect due to manufacturing/installation faults shall be supplied/executed at the Contractor's cost.
- 6.2 The service and maintenance to be performed and defects to be rectified and making good shall include but not limited to the following:-
- 6.2.1 Repairs and replacement of all equipment and accessories that become faulty due to manufacturing and installation defects whether it is under the manufacturer's warranty or not;
 - 6.2.2 Replacement and making goods of all wiring and accessories;
 - 6.2.3 Making good any damage to roads, buildings, drains, cables, pipes, concrete areas, paved areas etc. which had not been properly made good arising out of his work; and
 - 6.2.4 All other works deemed as necessary by the S.O or S.O's Representative.
- 6.3 All works shall be carried out as soon as the Contractor is being informed by the S.O or S.O's Representative or the occupant, and shall be completed within a reasonable time except under emergency situation. If the Contractor fails to comply with the above requirements, the S.O or S.O's Representative reserves the right to engage another party to carry out the work, in which case, the Contractor shall be responsible for all the expenses incurred.

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7.0 SHOP DRAWINGS AND AS BUILT DOCUMENTS

7.1 SHOP DRAWINGS

7.1.1 Two (2) sets of prints of shop drawings for construction and/or installation shall be submitted to the S.O or S.O's Representative for approval. The Contractor shall prepare and submit shop drawings for the whole work or parts of the work at least two (2) weeks before the work begins. If the shop drawings submitted are not acceptable by the S.O or S.O's Representative, the Contractor shall amend and re-submit the shop drawings within two weeks from the date of return of the shop drawings. No work shall be carried out without the shop drawings being approved by the S.O or S.O's Representative.

7.1.2 The shop drawings shall include and show the following:-

- 7.1.2.1 Co-ordinated dimensioned general arrangements, layouts and positions of accessories, equipment racks and all others necessary for the complete installation;
- 7.1.2.2 Schematic line diagrams of the installation;
- 7.1.2.3 The dimensioned general arrangements, layouts and routes of final circuits;
- 7.1.2.4 The dimensioned general arrangements, layouts, routes and positions of all lateral and vertical mains and/or sub-mains;
- 7.1.2.5 The dimensioned layouts and positions of all holes and cut-through in the walls and floors for the lateral and vertical mains and/or sub-mains; and
- 7.1.2.6 Co-ordinated routes for all cables laid external of the building;


7.1.3 The cost of all these shop drawings is deemed to be included in the Contract.

7.2 AS BUILT DOCUMENTS

7.2.1 As built document shall consist of but not limited to the as installed drawings, manuals, certificates, catalogues, inventories and parts lists.

7.2.2 The as installed drawings shall comprise of:-

- 7.2.2.1 Site plan;
- 7.2.2.2 External cable routes;

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7.2.2.3 Internal layout plans; and

7.2.2.4 Schematic diagrams.

7.2.3 These drawings shall be labelled at the lower right hand corner with the Electrical Contractor's name and address, date of commissioning, scale, drawing number (the drawing number to be obtained from the S.O or S.O's Representative), title and following particulars: -

JABATAN KERJA RAYA
CAWANGAN KEJURUTERAAN ELEKTRIK
CONTRACT NO.:

7.2.4 If the drawings submitted are not according to the actual installation at site and/or not acceptable to the S.O or S.O's Representative, the Contractor shall amend and re-submit the drawings within two (2) weeks from the date of return of the drawings to the satisfaction of the S.O or S.O's Representative.

7.2.5 Manual and documents for the installation shall be supplied. It shall comprise of:-

7.5.1.1 Installation manual;

7.5.1.2 Operation manual;

7.5.1.3 Service and maintenance manual;

7.5.1.4 Inventories and parts list;

7.5.1.5 Product data and catalogue;

7.5.1.6 Product test certificates; and

7.5.1.7 Installation test results.

7.2.6 Each of the as built documents shall be bound together with hard cover and submitted in minimum four (4) sets upon issuance of Certificate of Practical Completion of the project.

7.2.7 In addition, one (1) set of the as installed drawing shall be submitted in the form of original document, and four (4) sets in physical digital storage.

7.2.8 The cost of all these prints, manuals, tools etc. whether or not provided in the Bill of Quantities, is deemed to be included in the Contract.