

SECTION G**AUDIO / VIDEO EQUIPMENT****1.0 SIGNAL PROCESSORS****1.1 Stereo/Mono Graphic Equalizer, 31 or 15-Bands**

The graphic equalizer shall have 31 filters for each channel centered at the ISO standard 1/3 or 2/3 octave frequencies between 20Hz and 20,000 Hz. The filters shall provide either 6dB or 12dB of boost or cut and be set by 22.5mm linear controls. The front panel shall have the a +/-12dB continuously variable gain control, high-pass filter at 43Hz with 18dB per octave slope, a 6 or 12dB filter range select switch, an EQ-on switch and a power on/off switch. The inputs and outputs of the equalizer shall be active balanced and accessible via 3-pin XLR and ¼" jack. It shall have a 20Hz to 20.000Hz frequency response, less than 0.01 percent total harmonic distortion, less than -97dB noise level. +/-6 or +/-12dB gain, 44ohm balanced input impedance, 120ohm output impedance. It shall be operated from 220V 50Hz mains.

1.2 Digital Time Delay

The device shall employ a 16-bit digital linear conversion that maintains 20Hz to 20kHz bandwidth at 90dB dynamic range. It shall be single input to three independently programmable outputs. The device shall have a delay setting of up to 1.3 seconds in 20 microseconds steps. All input and output connectors shall be 3-pin XLR and electronically balanced.

1.3 Audio Distribution Amplifier

The amplifier shall allow the bridging of any audio line, adjusting the gain, and driving up to the number of outputs as required. It shall be operated between 150-600 ohms. It shall have built-in RF filler, balanced inputs and outputs and termination via barrier block terminals.

2.0 MIXING CONSOLE**2.1 12 or 24-Channel UR Audio Mixing Console**

The mixing console shall be a mainframe with plug-in channels input and output modules including the master and monitoring modules. The frame shall be self-contained.

The console shall have integral LED barograph meter for each Group Output signals, and LED meters to monitor the Left and Right Main Output signals. The meters shall be internally selectable to have Average or Peak ballistics.

Input connections to the frame shall be by XLR 3-pin type connectors for each microphone input and stereo ¼" jack sockets for each Line Input. Both Mic and Line Inputs shall be electronically balanced. The input modules shall have switch able (On10ff) +48V DC phantom power, phase reversal switch, mic/line gain control, channel routing switches, pan-pots. 4-band quasi-parametric EQs, PFL button and 100mm sliding fader. The input module of main mixer shall have 8 Mute groups assignment switches plus a SAFE switch for mulling all mute group selection switches within the module.

Output connectors shall be XLR 3-pin type, for all group outputs, and stereo mix output, and shall be electronically balanced. The auxiliary outputs, direct outputs, control room monitor outputs and insert send and return signals, shall be on ¼" stereo jack sockets, and shall be unbalanced, except the auxiliary outputs which shall be balanced and transformer isolated.

The nominal operating levels of the console shall be +4dB, both input and output. The sensitivity of the microphone input shall be between -72dB and -2dB. Insert send and return shall be nominally -2dB. Mains outputs and the returns shall be capable of operating at -10dBV.

An auxiliary return section with a 2 band EQ, HF (+/-15dB at 8kHz), and LF (+/-15dB at 60Hz), routed to stereo mix bus with level and pan controls, a PFL switch with LED indication and an ON switch with LED indication, and a control to feed a pre-fader signal to Aux bus 1; an identical return which can be fed from either the group output, or an external return, and fed to the stereo mix bus with level and pan controls, a PFL switch with LED indication and an ON switch with LED indication, a control to feed a pre-fader signal to Aux bus 1; and a Group Output level fader, calibrated in dB. It shall also be possible to route the group output signal to the left and right channels of the stereo mix bus, independently or simultaneously. and also route the return signal via the group mix bus to the stereo mix, with control of the return by the fader.

The Master Module shall be provided with an XLR socket for the connection of a talkback microphone with a level control and routing to auxiliary buses 1 and 2 or all buses, with internal linking for phantom power; a headphone output connector with a switch to divert the signal from the main outputs to the headphones; an internal oscillator set at 1 kHz, with level control and an On/Off switch; main monitor signal level control; source selection of mix or tape return to monitors, headphones and stereo meters; and an LED to illuminate when any PFL or AFL switch is activated.

The Master outputs shall have a delayed turn-on circuit operated by relay. The outputs shall have transformer balancing.

The Master Module shall have master level controls for auxiliary bus with a solo (AFL) switch with LED indication; a separate mono output fed from a sum of stereo output signals, with a level control; a BNC connector for the addition of Littleie or similar, and two faders for stereo mix level control. Two LED barograph meters shall be fitted to the Master Module to read the selected monitoring source, having internally selectable peak or average ballistics.

The Master module of the main mixer shall have 8 Master Mute/Scene switches and L/R and Mono output buses.

The 24-Channel Mixing Console shall have 24 input channels, 4 subgroups and 4 auxiliary/fold back sends.

2.2 8x4 Audio Matrix Mixer

The mixer shall be rack-mount system that provides programmable matrix for 8 inputs to 4 outputs. The inputs shall be electronically balanced and shall be switch able for microphone/line operation. The outputs shall be transformer balanced and feature automatic level control. It shall be possible to program the system using front panel control buttons. It shall incorporate microprocessor based control to allow instant recall of up to 4 preset configurations and remote control of all mixer functions.

The matrix mixer shall have a frequency response of 30Hz to 20kHz +/- 1dB, input noise of less than -120dB and greater than 90dB for common mode rejection.

2.3 Automatic Microphone Mixer

The mixer shall have four balanced mic/line inputs and two parallel outputs.

The mixer shall be capable of turning microphones On and Off with automatic gating. In a multi-microphone sound installation, the reverberant sound quality and feedback problems shall be gate on only by sounds arriving from the front within their 120 degrees acceptance angle. Other sounds outside the acceptance angle, including background noise, shall not gate the microphone On. The mixer shall also adjust gain automatically to prevent feedback as the number of 'On' microphones increases.

The front panel shall include rotary level controls for each input and output channels. Each input shall have its independently switch able low-cut filter which rolls off 6dB per octave from 170Hz and below. The automatic function of the mixer may be disabled by switching out at the front panel.

The unit shall be able to be cascaded to operate as an integral mixer with increased number of input channels.

Microphone inputs shall be 48volts phantom powered via the transformer center tap. An external connection panel shall be provided to allow the use of 48 volts phantom power.

The mixer shall have an overall frequency of 25Hz to 20kHz and a total harmonic distortion less than 0.5%. All inputs shall be able to gate within 4 milliseconds and hold for 0.1 to 0.4 seconds. Operation shall be at switch able thresholds of +16, +8, +4 or 0dB with attack/recovery time of 3 to 350 milliseconds.

3.0 AMPLIFIERS & ACCESSORIES

3.1 Power Amplifier

The power amplifier shall be a dual-channel model of solid-state design employing true complementary-symmetry output circuitry and capable of operating from 230V AC, 50Hz mains supply. The amplifier shall contain sensing circuitry to provide protection for the output transistors against temperature, excessive voltage, radio-frequency interference, shorted loads, and excessive output shift. The load shall be similarly protected against infrasonic signals, startup/shutdown transients, low ac line voltage and DC.

All controls shall be located at the rear of the amplifier, which shall include dual-channel/bridge-mono operation mode switch, and individual channel level controls. Input connections for each e channel shall include an octal socket for use with a plug-in bridging transformer or electronic accessory modules, 3-pin female XLR connector, and a barrier-strip connector. Output shall be a barrier strip connector.

Front panel indicators shall include an illuminated indicator for power on/off, signal clip, and protection activation. The power on/off switch shall located on the front panel.

The power amplifier shall accept a maximum input of 7.75V rms. It shall deliver rated power from 20Hz to 20kHz to 4 or 8ohms load at a maximum total harmonic distortion of 0.05 percent for both dual-channel as well as bridge-mono modes. Hum and noise shall be maintained at least 105 dB (A weighted) below rated output power. Frequency response shall be 20Hz to 20kHz +-1dB. Damping factor shall be greater than 200 at any frequency up to 1 kHz in dual mode with 8-ohms load.

3.2 70V/100V Output Transformer

The output transformer shall provide efficient transmission of amplifier power to distributed sound systems in installations which also requires transformer isolation between power amplifier and loudspeaker load. The output transformer shall have dual 4- and 8-Ohm primary-windings in the amplifier section and the secondary section shall provide isolated outputs to the loudspeakers. Frequency response at rated output shall be 20Hz to 25kHz with an insertion loss of no more than 1dB and total harmonic distortion of less than 0.05%.

4.0 MICROPHONES & ACCESSORIES

4.1 Wireless Handheld/Clip-On Microphone System

It shall be a system with RF transmitter in a dynamic handheld or condenser clip-on microphone and a true diversity RF receiver. The microphone shall have a cardioid pickup characteristic. The receiver shall employ amplifiers and multiple LC RF filtering. The receiver shall be switchable, adjustable mic/line audio outputs via XLR connectors, and BNC antenna connectors for termination of an antenna. The transmitter shall be powered from 9V alkaline battery and available in body pack version for clip-on microphone or integrated into hand-held microphone. The transmitter shall have silent On/Off audio mute switch and delivers an output of no more than 30mW of RF power over a Telecom's approved UHF frequency range (487MHz to 507MHz). There shall be feature for frequency selection up to 16 presets. The system shall have an audio frequency response of 60Hz to 18kHz with a signal-to-noise ratio of equal or better than 110dB at better than 0.4% at 1kHz harmonic distortion. The system shall have a nominal working distance of 30 meters with a 100dB or better dynamic range with SPL handling capability of 150dB for handheld dynamic mic and 120dB for clip-on condenser mic with a sensitivity of 1.5mV/Pa (for dynamic handheld) / 40mV/Pa (for condenser clip-on).

4.2 Handheld Dynamic Microphone

The microphone shall be a dynamic type with a frequency response of 50 Hz to 15 kHz. The unit shall have a cardioid polar characteristics, a sensitivity rating of -56dB or better and a nominal impedance of 150ohms. The pickup head shall feature built-in dynamic damping and P-pops filter. It shall be equipped with an on/off switch.

4.3 Gooseneck (Supercardioid Condenser) Microphone

The microphone shall have a miniature supercardioid pickup head mounted on a 18-inch flexible gooseneck (Slim-Neck Type) with a snap-fit foam windscreen. It shall have a frequency response of 50Hz-20kHz, a nominal 150ohms impedance, a dynamic range of at least 100dB with a SPL handling capability of 130dB re 1kHz at 1% THD, signal-to-noise ratio better than 67dB, sensitivity rating of -33dB or better re 1 V/1 Pa. It shall complete with a low profile XLR plug-in desktop base with built-in preamplifier.

4.4 Microphone Desk Stand

The stand shall be a low profile construction with an integral tension variable mount, die-cast base with protective pad and it shall have a fixed tube height of 76mm.

5.0 AUDIO/VIDEO PLAYBACK SOURCES/MULTI-MEDIA PLAYER**5.1 Video Cassette Player/Recorder**

The video cassette recorder/reproducer shall be a multi-system operates on S-VHS format tapes with high-fidelity stereo sound audio section. The tuner section shall incorporate NICAM decoder and shall also playback video tapes recorded in PAL, SECAM or NTSC video standards. The unit shall have infrared remote control system. The unit shall have tuning facilities for television broadcasting program.

5.2 Digital Video Disc/Video CD/Audio CD Player

The player shall be a multi-system that plays digital video discs or video CDs or audio CDs to provide high quality video image output with advanced digital noise reduction (DNR) features from a normal or extended 'storage capacity 5-inch compact disc. The player shall be DTS compatible with AC3 RF output. It shall incorporate controls such as direct access (disc digest)/track (track digest) selection, active picture, still/resume play, high speed search and power On/Off. All functions shall be controlled from its front panel as well as infra-red remote control unit. It shall be PAL and NTSC compatible. The player shall have M P3 and CD-RW function. It shall also have the following features :

- 10-Bit video DIA converter
- Digital video equalizer
- Digital RF processing LSI
- Enhanced vertical interpolated filters
- Full feed forward digital filter
- Dolby digital 24-Bit DSP

It shall have a frequency response of 2Hz to 22kHz at +/-0.5dB, signal-to-noise ratio of more than 107dB, distortion of less than 0.0028%, dynamic range of more than 97dB, wow & flutter less than 0.001% W Peak. The system output shall be available in various format . S-Video, Component. Composite with Stereo Audio outputs, optical digital and coaxial digital output.

It shall have high output resolution for MPEG-1 (Video CD) 352 x 240 dots (NTSC), 352 x 288 dots (PAL) and for still picture resolution, MPEG-2 (DVD) of 704 x 480 dots (NTSC). 704 x 576 dots (PAL).

6.0 AV MEDIA REMOTE CONTROLLER**6.1 AV Media Remote Control System**

The operational remote controller system is required to integrate the audio and visual media supporting services and lightings in the designated room. The chosen system shall be modular construction and shall be able to accommodate expansion of control functions to external devices by addition of modular interfaces. The central controller or decoder shall be installed into the equipment rack. The central controller shall be field programmable and utilizes non-volatile digital memory to store program data.

The following basic nature of control functions shall be incorporated onto the presenter control panels :

- (a) Raising and lowering of motorized projection screen
- (b) Interfacing to lighting dimming system
- (c) Raising and lowering of audio programmer volume
- (d) Operation of the video/graphics projector

- (e) Operation of the projector pantograph lift
- (f) Selection of video/computer sources
- (g) Operation of video program sources
- (h) Operation of audio program sources

All cabling required to interface with the lighting dimmers which are provided under the electrical works shall be included in this contract. 0-10 Volt voltage ramp card/device shall be provided to interface with dimming of house lighting.

6.2 The Control Unit

The media control system shall be based on RS 485 token passing local area network (LAN)/Ethernet communication. The control system shall support single and bi-directional RS232, RS485, RS422, PA422, MIDI, serial data, SMPTE and infrared protocols. Hardware parameters shall be defined by software in the system program. Interface with media devices shall be independent of motherboard to prevent noise and interference from external sources. The control software shall be centralized or stored in the system central processing computer, and downloaded to the appropriate control hardware. The system shall support Infrared communication mode. The system shall have 6 IR/serial/RS232 ports, 8 switch/contact inputs, 16 isolated relay closures, 6 bi-directional RS232 or RS422 or RS485 ports, 8 digital analog Input/Output ports, and local control front panel with a 40-character LCD display and LED indicators. Additional interfacing modules and cables if required shall be provided to ensure optimal Integration to external media devices.

6.3 Wireless Colour Touch Screen Control Panel

The touch panel shall use 5.7-inch diagonal LCD with 320x240 pixels resolution. The LCD panel shall be passive matrix colour LCD touch panel display. The LCD screen shall be fluorescent backlit. It shall communicate with the control system via 2-way bi-directional Radio Frequency (RF) transmission. It shall support the uploading and downloading of all panel programming and display configuration via RJ11, RS232 connection on the rear of the unit directly into a personal computer. Power supply, battery pack and charger shall be integral parts of the panel base. The fully charged battery shall be able, to operate continuously at minimum 2 hours. Touch detection shall incorporate a 4th order low pass filter and touch activation sensitivity shall be adjustable. It shall include resident software for designing panel graphics and control scenarios without the use of external computers. Graphics design feature shall include circles, round, rectangles, squares, ellipses, radiuses, poly-lines, variable line weights, button shadowing and shading, background shading and variety of text fonts. It shall include multiple panel display tracking and message windows to accept message transmitted by the control system. The touch panel shall include an RS232 port for direct interface to a "mouse" type graphic device for operating the software. The unit shall include an adjustable tilt case. It shall be designed for installation on the Presenter's lectern.

7.0 PROJECTORS AND DISPLAYS

- 7.1 Projection screen shall be motorized roll-up version for ceiling and/or wall installation to be approved by the Architect/Consultant. The transport mechanism shall be blocking worm gear motor with automatic electric switch-off at both end screen positions, with additional safety limit switch. The motor shall be maintenance-free, secured against torsion at motor side and vibration free. It shall be provided with a wall-mounted screen operation switch for raising, lowering and stopping of screen rolling motion. The screen shall be flat, free from hang wrinkle-free & curl edge. The screen shall come with black edge borders, seamless and the projection surface shall be matt white. The switch shall be 'noiseless' when in-use and selection shall be subjected to approval and finishes selected. to Architect/Interior Designer's approval. The screen surface shall have a two times axial reflective gain and falling to no less than 1.5 gain at 40 degrees off axis. The screen shall have a useable surface of Width By Height in meters as indicated in the drawings.
- 7.2 The projector shall deliver full colour video using data light valve and 3-LCD technology. It shall be equipped with 2x 200watts UHP lamp and three active matrix 1.3" diagonal XGA poly-silicon LCD panels with micro-lens arrays. Each LCD panel shall have 1024 x 768 pixels. The projector shall accept computer signal with graphic format up to 1280 x 1024 pixels/85Hz. The projector shall have the following inputs : 1 x RGBS(HV) analog (on 5 BNCs), 1 x VGA/SVGA (15-pin D-Sub), 1 x standard composite video (on BNC), 1 x S-video (on 4-pin mini-DIN)x 1xDVI. The projector shall also have both a IR wireless remote control and a wired remote control communication port (mini-jack) to allow external controls including : On/Off, Blanking/Mute, switching of its various input ports/sources. It shall have a full field (full white/full black) contrast ratio of greater than 400:1. It shall deliver light output of greater than & **4000 ANSI** lumens. It shall of capable of display its input sources in seamless switch formal between video to data. data to data, data to video, etc.: selectable transition effects such as fade-in-fade out, box-in-box-out, etc.; and picture-in-picture showing multiple sources simultaneously in windows. It shall also have features for geometry adjustments (motorized zoom, focus and lens shift) through 2 32 communication port to allow up to 120% off-axis projection and 25% keystone correction. The projector shall have lens with throwing ratio of 1.3 - 1.4:1 screen width. (Note : the projector lens shall have a throwing distance to meet the specified minimum image size on screen, based on the designed projector location as shown in the drawings). The lamp shall have a lifetime of 1500 hours (dual lamp mode). The noise level of the projector shall not exceed 39dBA measured at 1 meter from the ventilation fan side. The unit overall operating noise level shall not exceed the noise criteria of the space it is serving.
- 7.3 Video/RGBS/Audio Matrix Switcher
- The Switcher shall be a 12 inputs by 4 outputs digitally controlled analog video. data and audio switcher/router with an video bandwidth of 200MHz (-3dB) and audio bandwidth of 100kHz. It shall be a modular design that accepts 12 input modules with 8 available analog (RGBS/RGBSHV) outputs. It shall be capable of switching multiple inputs and outputs of composite video, S-video, RGB with separate horizontal & vertical sync and stereo audio signals. Each switcher input shall have one audio channel (stereo) and 5 BNCs that are capable of being populated/customized to suit the requirements of any system. The Switcher shall have feature with capability to switch an audio signal with its corresponding video signal and allows any audio signal to be selected with any video signal simultaneously to one or all output in ,any combination via the front control panel or RS232 remote. However, it shall also provide the break-away capability. The Switcher shall also be capable of switching separate horizontal and vertical sync to ensure proper

sync polarity to ensure a more stable image. It shall be capable of switching video to high resolution graphics signal with a frequency range of 15-100kHz.

The Matrix Switcher shall have performance specifications equal or better than the following :

Video / Input

Bandwidth	:	200 MHz (-3dB)
Impedance	:	75 Ohms
Levels	:	0.5 to 2 volts p-p
Crosstalk	:	-45dB at 10 MHz

Video Output

Gain	:	Unity
Impedance	:	75 Ohms

SYNC

Impedance	:	75 Ohms
Level	:	5 volts p-p (TTL)
Polarity	:	Follows input
Formats	:	RGBS, RsGsBs, RGsB, RGBHV

Audio Input

Type	:	12 inputs, stereo. Balanced or Unbalanced
Impedance	:	Balanced 25 kOhms. DC coupled Unbalanced 50 kOhms. DC coupled
Maximum Level	:	+19.5dBu (Balanced or Unbalanced)
CMRR	:	> 75dB. 20Hz to 20kHz
Input Gain Adjustment	:	-15dB to +9dB, adjustable per input

Audio Throughout

Routing	:	12 x 4 stereo matrix
Response	:	+0.05dB, 20Hz to 20kHz
Maximum Channel Gain	:	15dB (input gain at max, balanced output)
THD + Noise	:	0.03% at 1 kHz. 0.3% at 20kHz +15dBu input. +21dBu output Balanced input and output
S/N ratio	:	> 90dB, output 2ldBu balanced
Adjacent Input Crosstalk	:	> 65dB typical at 20kHz > 80dB typical at 1 kHz > 80dB typical below 60Hz
Stereo Channel Separation	:	> 80dB at 1 kHz; > 60dB at 20kHz

Audio Output

Type	:	4 outputs, stereo (Balanced and Unbalanced)
Impedance	:	50 Ohms Unbalanced, 100 Ohms Balanced
Gain	:	Unbalanced 0dB, Balanced +6dB
Gain Error	:	+0.1dB channel to channel
Drive (Hi-Z)	:	>+21dBu, balanced or stated %THD+N
	:	>+15dBu, balanced or stated %THD+N

Control

Serial Control Port	:	9-PIN STANDARD rs232 AND rs422
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7.4 Video/Data Source Selector

The source selector shall be a digitally controlled video and data switcher with 300MHz bandwidth. It shall be modular design mainframe that accepts 8 input modules. There shall be 5 types of input modules available for RGSB, RGBHV, RGSB, NTSC (PAL) as composite video or S-Video and a left & right audio input. The mainframe shall have a front panel with 7 segment LED display to indicate selected source or display error and warning codes.

7.5 Projector Lift

The projector lift shall be designed for "Three-Step" operation.

- Fully extended to 900mm below Ceiling for service;
- retractable to a level for projection onto the screen shown in the drawings; and
- retraced into the ceiling bulkhead/projector compartment when not in used.

The unit shall come with safety chain to be mounted to the building structure to lock and hold the projector in the event of primary component failure. The mechanism shall enable the system to operate quietly and un-obstructively.

It shall be operable on IR remote control and interface with the AV remote media control system. It shall be structurally sufficient to support the video projector selected.

7.6 PLASMA / LCD MONITOR

LCD monitor shall come with the following specs or equivalent;

- (a) High definition LCD WXGA display, 1366 x 768p
- (b) HD ready for the highest quality display of HDTV signals
- (c) Pixel Plus 2 HD improves details in standard TV and HDTV
- (d) 2 Channel active ambilight enhance the viewing experience.
- (e) 2 integrated NXT Monolith speakers with amazing performance.
- (f) USB and Memory-card for instantly playing multimedia
- (g) HDMI for full digital high definition connection

8.0 AUDIO / VIDEO CONFERENCING

8.1 The video conferencing equipment shall offer flexibility, reliability and a robust architecture to suit the board room configurations. It must be able to cater for capacity ranging from 5 to 20 participants and capability of doing conferencing of 4 parties. The system shall come integrated with video, voice, data and web capabilities. Suitable light setting, camera position in relation to the screen or LCD monitor, board room size and configurations shall be taken into consideration when proposing the video conference equipment

8.2 The audio conferencing equipment shall come with Acoustic Clarity Technology that adapts to different meeting environment and at the same time, provide high fidelity voice clarity for all participants. Participants shall be able to speak at a normal, natural conversation level and be heard clearly from up to 20 feet away from the microphones. The system shall come with a alphanumeric keypads with loudspeaker volume adjustment and 2 side extension microphones.

9.0 CABLING, INTEGRATION, TESTING & COMMISSIONING

- 9.1 The locations of the equipment audio and/or visual termination receptacles are indicated in the drawings, otherwise, optimal appropriate locations should be proposed. The locations will be subjected to minor adjustments and as instructed by the PM/Designer.
- 9.2 All audio & video control cables and works required for the installation of the complete Audio Visual System shall be provided and installed in this Contract.
- 9.3 All conduits and trucking required shall form part of this Contract. As necessary, the Sub-contractor shall drill, chip and core any surface required for his installation.
- 9.4 All sound systems provided shall be equipped with facility for overriding the special PA system for emergency or special announcement. The 24 Volt DC line shall be provided under electrical work for overriding the special sound system provided herein. But the Sub-Contractor is required to coordinate with the Electrical Contractor on the incorporation of the overriding system.
- 9.5 Manual operation system shall be provided to operate each AV media system when the wireless remote control unit is not working.
- 9.6 All video, computer & audio termination receptacles shall have specifications equivalent or better than BNC type connectors. And all computer receptacles shall be in RGB analog. V-Sync & H-Sync.

All microphone termination receptacles shall have specifications equivalent or better than 3-Pin XLR Type connectors.

All amplifier/speaker termination shall have specifications equivalent or better than 'Neutrik' Speak-On Connectors.

All finishes and sizes of receptacles Including microphone, computer/audio/video, volume control switches, screen switches, projector & lift switches, etc. shall be subjected to PM/Designer's approval.

9.7 Testing & Commissioning

After the completion of installation, the Sub-Contractor shall satisfy himself that it is properly installed by carrying out site tests, measurements, adjustments and visual examination of all components before requesting for the Consultant to arrange a time for system handing-over. At the time for system hand-over, the Sub-contractor must ensure that all relevant measurement and alignment apparatus and the appropriate technicians are present.

The Sub-Contractor must submit two (2) copies of the operation and maintenance manuals complete with all as-built system schematics, equipment list, brochures and operation instruction handbooks for each piece of equipment before handing over.

9.8 Training

Training shall take place after the system installation is operational.

The Sub-contractor shall be responsible for training the Employer' appointed technicians on the full operation and maintenance of the installed systems. The number of personnel to be trained shall be nominated by the Employer.

- 9.9 A twelve(12)-month defects liability period shall commence immediately after the date of system acceptance. During this period the Sub-contractor shall warranty all equipment and materials supplied against manufacturing defects. The defects liability period shall also cover workmanship on the installation. The Sub-contractor shall take up all necessary insurance during the defects liability period.

During the defects liability period, the Sub-contractor shall respond to the Employer's request for service and repair within **24 hours**. The Sub-contractor shall submit inspection or service report for each visit.

The Sub-contractor shall guarantee availability of local service by factory trained ersonnel from the authorized distributor of equipment manufacturer. The distributor shall have available stock of the manufacturer's standard parts.